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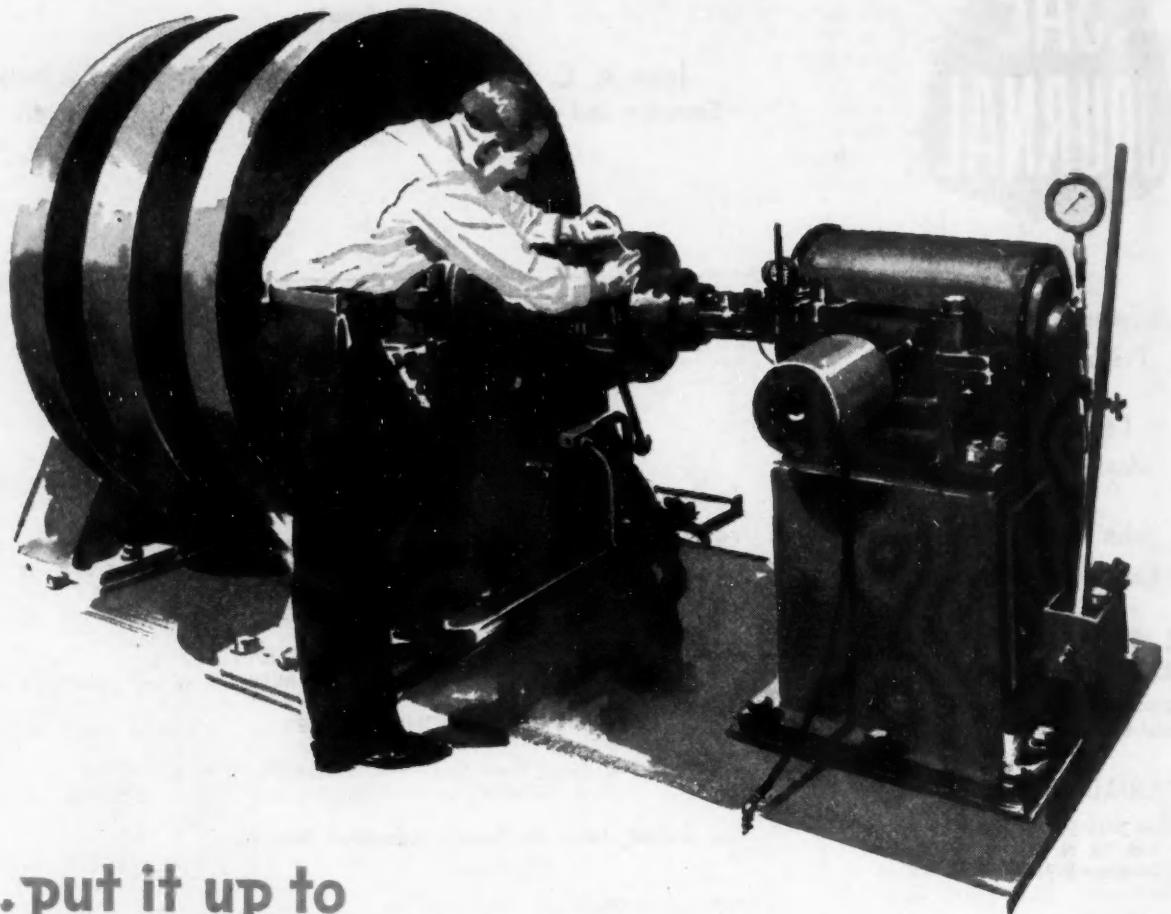
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MARCH

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OVER 7 OUT OF 10 AUTOMOTIVE VEHICLES EVER BUILT HAVE BEEN BETTER BECAUSE OF BENDIX

To Our Readers. . .

A strike of typesetters is responsible for this March issue reaching you some 30 days late. It is responsible also for the editorial section being reproduced by photolithography - from proofs of type already set but not locked up in forms to permit running on regular presses.

Since the men who run the printing presses and do the binding did not strike, it was possible to run the advertising pages in the regular way - because advertisements come to us as engraved plates; no typesetting is necessary.

The editorial section of your April issue will be reproduced by photolithography from typewritten pages - since no new type can be set until the strike is over. Pictures and line drawings will be included as usual.

SAE is glad to be able to continue to serve members with current technical information and to carry its advertisers' messages in serviceable form during this trying period of strike-born production and cost difficulties.

John A. C. Warner
Secretary and Gen. Manager

ON DETERGENT OILS

■ Says Engine Builder...

BASED ON PAPER* BY **CARL T. DOMAN**

Vice-President and Chief Engineer, Aircooled Motors, Inc.

We can get along without compounded oils by using straight mineral aero oils, shows Doman. Oil engineers argue detergent lube's advantages already are emerging, with greater improvement expected.

LIGHT plane flight experience has shown straight mineral aero oil to be at least as good as some detergent types and often less troublesome.

For one thing, bronze valve guides wear rapidly with heavy-duty types of detergent oil. One way of getting around this trouble is with a cast-iron instead of a bronze guide. While most detergent oils do show up to advantage with cast-iron guides, good service is also possible with a good grade of straight mineral aero oil.

Engine manufacturers could safely recommend an SAE 40 straight mineral oil for temperatures above 40 F and an SAE 20 grade down to 0 F.

Some operators using detergent oils also report an alarming increase in spark-plug fouling. When it gets into the combustion chamber this type of oil leaves an unusual and harmful deposit on spark-plug electrodes.

While tests show detergent oils to reduce deposits on piston rings and in valve guides, need for them in service is open to discussion. Field experience proved them unessential if the oil is kept clean and engine operating temperatures are kept under control.

Examination of one engine after 675 hr of operation on SAE 40 straight mineral oil revealed no excessive deposits. Valve guides had no abnormal sludge formation; the oil pan was perfectly clean. But the operator of this particular engine was careful to change the oil every 25 hr. Another engine examined after 550 hr on straight aero oil showed about the same results.

If use of compounded or detergent oils is on the

increase, as pointed out by one of the major oil companies, incompatibility of compounded types with straight mineral oils opens the door to trouble. Here's what raises the question:

Detergent additives in oil hold in suspension foreign materials that might otherwise deposit themselves on internal engine surfaces. But an engine operated for any length of time on straight mineral oil is coated with a normal deposit on its insides. Changing to a detergent oil after such a period may loosen some of these harmless deposits, with plugged oil screens, oil lines, and hydraulic lifters a distinct possibility. This situation makes it the joint responsibility of airplane and engine makers as well as oil dispenser to acquaint fliers with the possibility. Perhaps some routine procedure during the switch from nonadditive to additive oils will eliminate the danger.

Another situation needing action is the grading of all light airplane engine oils. Some aircraft engine manufacturers specify oils in Saybolt seconds at 210 F. On the other hand, light airplane operators tend to call for aviation oil by SAE motor oil grades. But confusion leading to trouble is possible with this dual system in use since SAE 60 oil is not equivalent to Grade 60 aviation oil, but rather Grade 120.

Since many operators prefer the SAE nomenclature, the industry should adopt it as standard terminology for aviation engine oil. But that's where the line should be drawn on automotive practice. Motor oils offer no special advantage in aircraft engines.

(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

*Paper "Lubrication Problems Encountered in Light Plane Engines," was presented at SAE National Fuels & Lubricants Meeting, Tulsa, Nov. 7, 1947.

for Light Plane Engines

■ Say Oil Technicians ■■■

BASED ON DISCUSSIONS BY **W. V. Hanley**

Standard Oil Co. of Calif.

H. R. Kemmerer

Shell Oil Co., Inc.

E. F. H. Pennekamp

Standard Oil Development Co.

MANY current difficulties with light aircraft engine detergent oils are not unlike those of any other new product for a still-to-be pioneered industry such as the small plane one, agreed all discussers. Once plane and engine makers, operators, and oil suppliers learn how to cope with idiosyncrasies of these engines, research will develop detergent oils well-suited to low horse-power engines.

Too much should not be expected at present of additive oils since most were designed for heavy-duty ground vehicles, Pennekamp advises. They cannot be used indiscriminately in aircraft engines. Detergent oils designed specifically for light plane engines, with proper emphasis on their operating problems, perform well regardless of valve guide material—cast iron or bronze.

Over 40 million miles of airline test flights showed essentially no difference between compounded and un-compounded lubricants on replacement rate of bronze valve guides. Many automotive detergent-type oils, however, will seriously corrode valve guides.

Past experience also indicates the need for detergents in light aircraft oils depends on engine design, operating and maintenance practice. Some operators use nonadditive aero oils with better success than those using detergent types. At first glance seemingly insignificant differences in flight and overhaul procedures seem to make the differ-

ence. But ring and valve sticking from excessively high temperatures in the ring belt area and around the valve guides is just as disconcerting whether poor cooling stems from climb at excessive angles of attack, insufficient cylinder finning, or poorly-designed cowling.

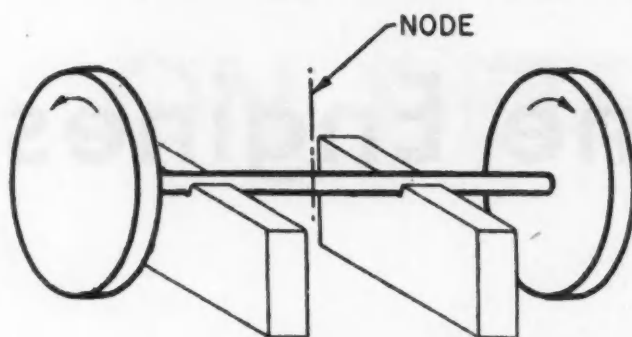
Head temperatures on personal airplanes run abnormally high, judged by airline engine standards. During summer months they frequently exceed 500 F, even with proper maintenance of cowling and engine baffles. In many cases poor maintenance boosts them even higher. In a field survey, for example, airplanes of one particular make were found with one or more of the inter-cylinder baffles missing on 80% of the airplanes examined. High cylinder temperatures and use of straight-sided pistons usually limit overhaul periods to between 500 and 600 hr. The same engines, running on high-quality compounded aviation oil with proper clearances, operate 1500 hr between overhauls.

Kemmerer agrees with Doman that two grades can adequately cover the air temperature range for most light plane service. But for best operation, he believes thermostated oil temperature control could be profitably used for such practice.

Deposits May Not Loosen

Purging action of detergent oils when first used in engines formerly operated on nondetergent types might loosen previously-formed deposits, agrees Hanley. He says this can be pronounced in relatively cold-running automotive type engines in which soft sludge is formed with uncompounded oils. Deposits formed with uncompounded oils in hotter-running aircooled aircraft engines are generally baked on as a hard enameled surface that resists purging.

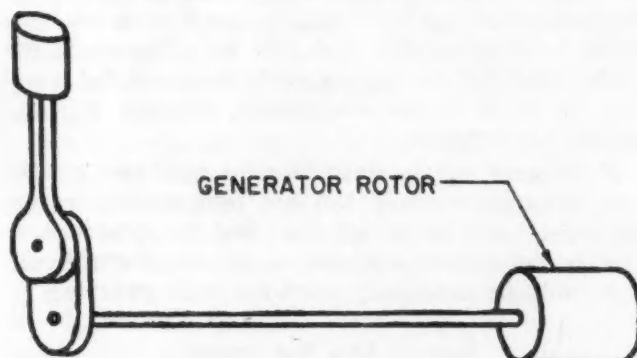
Switch to SAE number designations and viscosity at 210 F would be undesirable for the light plane market, the discussers feel, unless the entire aviation oil field and the armed services also changed to this practice. Kemmerer says separate grade designations would avoid confusion since, technically, automotive and aircraft engine oils are two distinctly different products.



1. This example should help explain the complex theory of torsional vibration in simple terms. Suppose we have a pair of flywheels attached to the ends of a flexible shaft. Assume that the bearings permit only rotary motion. If we twist the flywheels, they will vibrate torsionally in opposition to each other.

A point at the center of the shaft – the “node” – will not move at all. But it obviously must transmit the vibratory torque.

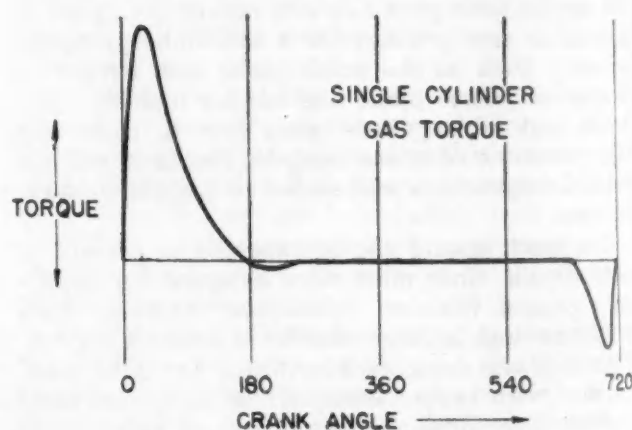
The rate of oscillation or frequency, in cycles per minute or second, depends both on the flywheels' moments of inertia and on shaft stiffness. It is easily calculated for a simple system. The free vibration we started will die out rapidly because of bearing and shaft friction.



2. Now suppose we replace one of the flywheels with a single-cylinder engine and the other with a generator, the moments of inertia remaining the same. This is illustrated above.

The system still will have a tendency to vibrate in torsion. This is now further encouraged by the fact that engine torque is pulsating.

If we assume a natural frequency of 1000 cycles per minute and consider a four-cycle type engine, we find the system develops a violent, steady torsional vibration as the firing frequency approaches 1000 cpm (equivalent to a speed of 2000 rpm). This torsional vibration is superimposed on the steady shaft rotation. But we also find vibrations of the same frequency at 1000, 667, 500, and other rpm's. This is understandable if we examine the diagram of engine torque fluctuation. At right is a typical one.



3. Here positive and negative torques due to firing and compression are evident. (Inertia torques due to varying piston motion have been omitted for clarity.) If firing impulse coincides with every natural frequency wave, or every other wave or third wave, it will reinforce vibration.

Mathematically integrating responses of the system to torque fluctuations for all important working conditions is conceivable, but in most cases impractical without an 18,000-tube calculating machine. In practice we usually use the mathematical trick of replacing the torque diagram with equivalent sine and cosine series of Fourier and consider each term or harmonic separately.

What Is T

BASED ON A PAPER* BY

L. F. HOPE

Research Division
General Motors Corp.

*Paper "Methods of Measuring Torsional Vibration," was presented at SAE Detroit Section, Nov. 3, 1947.

Is Torsional Vibration?

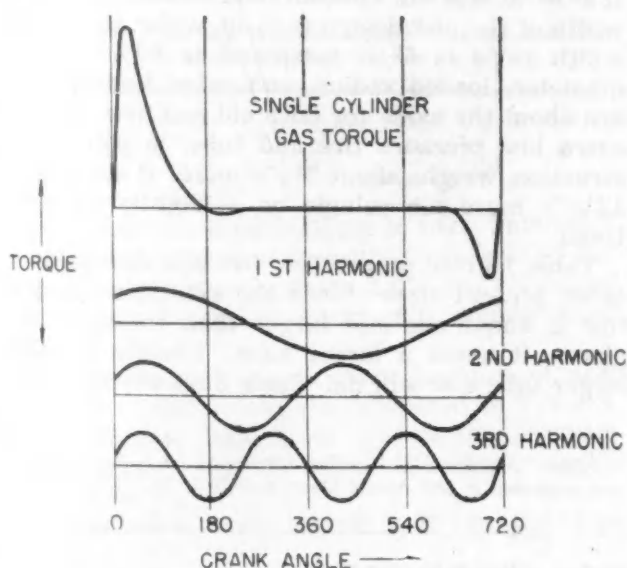
Today's highly-loaded truck and bus engines transform torsional vibrational from a "long-hair" theory to a practical automotive engineering problem, says Hope. Need for more bearing area, conservative water jacketing, and more complicated accessory drives spreads out the shafting so that it's more susceptible to torsional vibration.

He reports that unorthodox engine and drive arrangements for the sake of improved vehicle layouts together with the trend toward higher specific power outputs and reduced manufacturing costs are bringing torsional vibration into prominence. And diesel engines with their greater peak pressures and torque fluctuation pose an ever-present possibility of crankshaft breakage. Careful design supported by continued

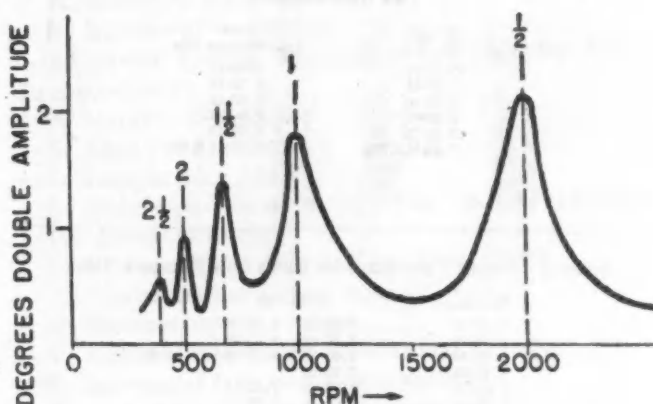
development must guard against it.

In this article Hope explains torsional vibration and how it is calculated. The paper on which this article is based is available from SAE, Price 25¢ to members, 50¢ to nonmembers.

Hope was a member of the SAE Torsional Vibration Committee that developed SAE Special Publication No. 5, Evaluation of Effects of Torsional Vibration. He authored one section of this publication which deals with torsional vibration instrumentation and measurement, stress calculations, and design applications of torsional vibration determinations. Copies of this 578-page treatise are available from the SAE Special Publications Department for \$5.00 to members and \$10 to nonmembers.



4. Sketched above are the first three harmonics of the equivalent series for the torque diagram at left. Response of a system of shafts and masses to a sine wave of torque is sufficiently easier than integration to permit some calculation. Each harmonic will excite vibration; at the proper sub-multiple of the engine's fundamental critical speed it will come into resonance.



5. This depicts a possible response curve - vibration amplitude versus engine speed - for this example. In more complicated engines, the points of applications of impulses and their timing are such that some harmonics reinforce and create serious amplitude; others almost or entirely cancel.

Firing impulses are not the only source of excitation for torsional vibration. Fluctuating loads, universal joints running at angles, angular vibrations of gear boxes, and camshaft load fluctuations are a few of the additional sources of torsional vibration excitation that may be encountered in vehicle work.

Announce Facts About N

What They Are...

BASED ON PAPER* BY

W. E. Shively

MANAGER, TIRE DESIGN
THE GOODYEAR TIRE & RUBBER CO.

THE new extra low pressure tire for passenger cars is 8 to 12% larger in cross-section; contains 12 to 25% greater air volume; operates best at a

24-psi maximum pressure, which is 4 psi or 14% less than in old conventional types. This softer tire can be adapted to new cars without basic design changes.

"Exactly what's the difference between my old tires and these new ones?" the average car owner might ask. Let's compare the 6.70x15 extra low pressure tire with conventional 6.00x16 which it replaces, shown in Fig. 1, both inflated on standard recommended rims. (Though this comparison is for one make of tire, it's similar in most respects to others.)

Width of the new tire on a standard rim is 0.45 in., or 8% greater than the old one. Inflation pressure for the new is 24 psi compared to 28 psi for the old. The softer tire's rim diameter is 12 in.; it's 16 in. for its conventional counterpart. Rim width of the new design is 1/2-in. wider, so that rim width ratio is 67% compared to 64%. Overall diameter, loaded radius, and rated load capacity are about the same for both old and new. But the extra low pressure tire and tube, in cotton construction, weighs about 2 1/2% more. It also carries 12 1/2% more air volume on a slightly narrower tread.

Table 1 gives proper new tire size for replacing other present sizes. Since the extra low pressure tire is about one size larger than the one it replaces, it needs a larger tube. Usually the next larger tube size will do. Table 2 shows the proper

Table 1 - Present Tires and Their New Extra Low Pressure Tire Replacements

Present Tire Size	Extra Low Pressure Size
5.50-16	6.40-15
6.00-16	6.70-15
6.25-16	7.10-15
6.50-15	7.60-15
7.00-15	8.20-15
7.50-15 6 Ply	8.90-15 6 Ply

Table 2 - Proper Tube Sizes for Extra Low Pressure Tires

Tire Size	Tube Size	
6.40-15	6.00-15	6.40-15
6.70-15	6.50-15	6.70-15
6.70-16	6.50-16	6.70-16
7.10-15	7.10-15	6.25-16
7.60-15	7.00-15	7.60-15
7.60-16	7.00-16	7.60-16
8.20-15	7.50-15	8.20-15
8.20-16	7.50-16	8.20-16
8.90-15	8.90-15	
8.90-16	8.25-16	8.90-16

*Paper "Application of Extra Low Pressure Tires to Passenger Cars" was presented at SAE Annual Meeting, Detroit, Jan. 14, 1948.

Table 3 - Dimensions and Engineering Data of New Versus Old Tires

Present Size	5.50	6.00	6.25	6.50	7.00	7.50	8.00	8.25	8.50	8.75	9.00
E. L. P. Size	6.40	6.70	7.10	7.60	8.20	8.90	9.50	10.10	10.70	11.30	11.90
Section Diam. Inches	5.65	6.25	6.70	7.10	7.60	8.20	8.90	9.50	10.10	10.70	11.30
Inflation Pressure Psi	30	28	26	24	22	20	18	16	14	12	10
Load - Lb	825	915	920	985	1005	1090	1145	1225	1400	1410	1410
Rim Diam. Inches	16	16	16	16	15	15	15	15	15	15	15
Rim Width Inches	3 1/2	4 1/2	4 1/2	4 1/2	5	5 1/2	5 1/2	5 1/2	5 1/2	5 1/2	5 1/2
Overall Diam. Inches	27.33	27.27	28.35	28.21	28.95	28.71	28.10	29.13	29.05	30.26	31.48
Loaded Radius - Inches	13.64	12.97	13.45	13.31	13.67	13.51	13.38	13.66	13.68	14.11	14.73
Weight - Tire and Tube Lb	23.25	24.07	25.50	26.04	27.92	27.53	28.55	30.00	31.47	33.97	42.11
Air Volume Cu Inches	1345	1720	1650	1865	1915	2170	1920	2410	2285	2875	3395
Tread Width Inches	4.10	3.94	4.54	4.29	4.70	4.40	4.93	4.62	5.32	5.05	5.50
Revolutions per Mile	758	761	734	739	718	724	736	715	721	687	659

ut New Softer Tires



6.70 - 15

E.L.P. TIRE PRESENT TIRE

ON 4 1/2" RIM



6.00-16

ON 4.00" RIM

Fig. 1—One size of the new extra low pressure tires compared with its equivalent present-type size

new tire and tube combinations to use. This table lists both the extra low pressure tire size and the conventional tire size in which it fits properly since most manufacturers no doubt will double-brand tubes.

Weight, dimensions, and other features of new and old tire equivalents are compared in Table 3. A study of these data shows the new tire program achieves some very desirable objectives. Here's what it does:

1. Establishes more logical and realistic size increments.
2. Establishes more significant and modern name sizes.
3. Standardizes on the 15-in. diameter wheel.
4. Maintains interchangeability of new and old type tires.

Car manufacturers like the new size names because they reflect the true, increased tire size. And

continued on page 28

What They Do...

BASED ON PAPER* BY

G. H. Parker and Edgar Shay

CHRYSLER CORP.

NEW ride-improving soft tires bring much closer the car engineer's goal of boulevard ride on rough roads. Engineering tests show the new extra-low pressure tire gives big gains in car ride comfort for but a small sacrifice in other features.

Its advantages:

1. Increased cushioning;
2. Reduced body shake;
3. Improved cornering;
4. Lower rolling resistance and slightly better fuel economy;
5. Improved flotation;
6. Less road noise;
7. Longer tire life;
8. Improved life of many other car components.

Its disadvantages:

1. Increased steering and parking effort;
2. Increased cornering squeal;
3. Blanketing of brakes;
4. Slightly decreased performance;
5. Increased tire and wheel weight.

Conspicuous difference between the low pressure tire and conventional ones is the softer ride. The new tire's enveloping power—ability to surround or to deflect locally around road surface irregularities—allows it to negotiate many road irregularities with little or no vertical disturbance of the car wheel. Fig. 1 illustrates the difference in enveloping ability between a new tire and its old-tire equivalent.

This reduction in car-wheel bounce offered by the new tires was demonstrated with 54-in. diameter chassis rolls, with 1-in. cleats so placed on

*Paper "Extra Low Pressure Tires for Passenger Cars," was presented at SAE Annual Meeting, Detroit, Jan. 14, 1948

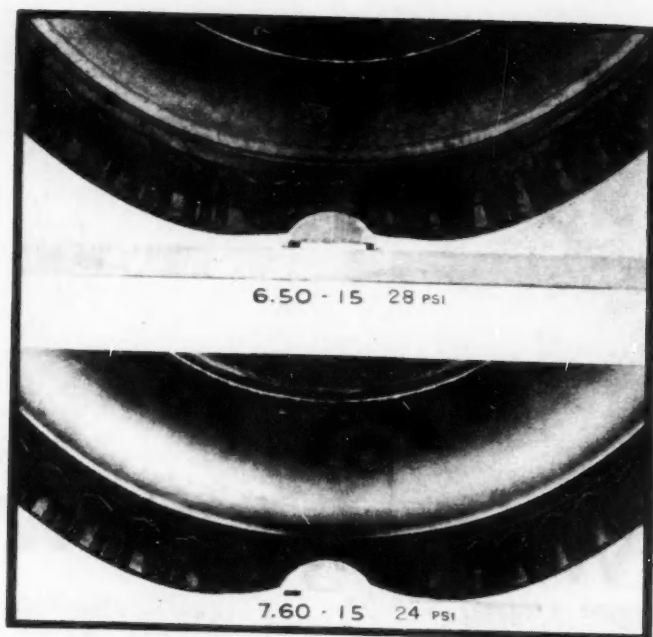
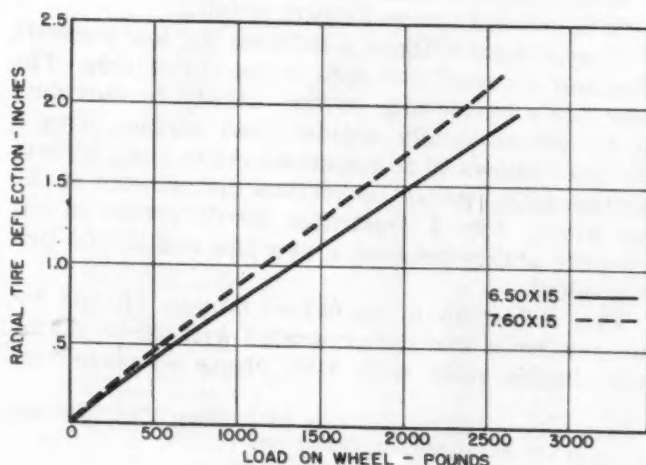


Fig. 1 - Relative enveloping power of present-type tire (top) and its equivalent size in the new softer type (bottom). Both tires are under a 1000-lb load and inflated to their proper pressures, as shown



Fig. 2 - Tests on cleated chassis rolls show the softer tires reduce the natural frequency of unsprung masses, cushioning the ride



the rolls to get proper excitation frequencies at reasonable roll speeds. Results of a part of this test, made on a right front wheel, are shown in Fig. 2. Note that the new tire reduces wheel spindle movement by $\frac{1}{4}$ to $\frac{3}{4}$ in. throughout the range. Additionally, natural frequency of the unsprung mass comes down from 620 to about 590 with the new tire. Both greater enveloping power and lower radial rate are responsible for this. Fig. 3 charts radial rates for an old and new tire of comparable size.

Another chassis roll test was made with only one cleat on the roll to simulate an occasional bump on the road hit by the car wheel. Curves in Fig. 4 trace actual vertical wheel-spindle travel when striking this 1-in. cleat at 30 mph. The new tire reduced maximum wheel disturbance from 1.16 to 0.83 in., or 28%.

Shake Shackled

As expected, the wheel and axle disturbance reduction also makes a worthwhile diminution of body shake. Fig. 5 bears this out. These data were derived from tests on two different size cars. Modified pedometers were placed at strategic points on the car and runs were made back and forth over a given course. "H" and "V" designate horizontal and vertical shakes.

These tests show the new tires reduce body shake 11 to 19% - a considerable decrease of a disagreeable phenomenon.

Resist Side Loads

Third improvement found with these new tires is greater tire stability or cornering power. (Cornering power is the tire's ability to maintain the wheel's course with minimum sidewise deviation when subjected to lateral loads, such as turning a corner, gusty side winds, and changes in lateral slope of pavement. A tire with greater cornering power is more stable since it requires smaller steering-wheel motion for any needed directional correction.)

But installing low pressure tires on old rims reduces cornering power to less than that of the old tire. Increase in rim width can more than regain this loss. Rim widths adopted by Chrysler take full advantage of the new tire's better cornering-power potential. Test drivers frequently call attention to the new tire's superiority in taking

Fig. 3 - The new tire deflects more with load, according to these results from tests on a flat surface

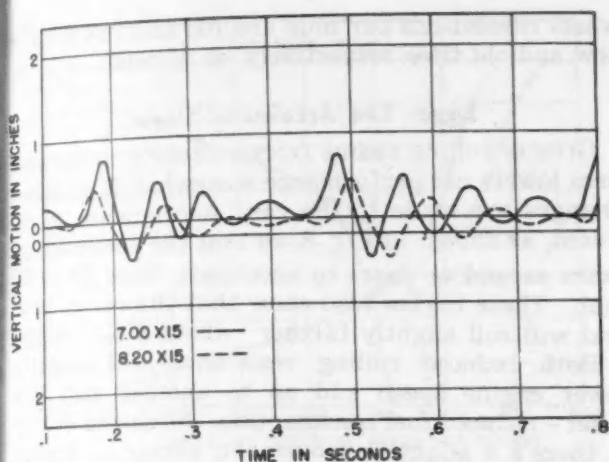


Fig. 4—These curves, charting test results, reveal that replacing an old-type tire with a new-type equivalent lowers maximum wheel bounce 28% when the wheel on the road strikes an occasional 1-in. irregularity at 30 mph

PEDOMETER LOCATION & READINGS								
	H ₂	H ₄	H ₆	H ₇	H ₁₀	V ₁	V ₂	AVERAGE
CAR NO. 423 - OLD TIRES								
	68	19	67.5	147.5	53	64.5	45	
NEW TIRES								
	57	20	50	116.5	39	58.5	51	
% CHANGE								
	-16	+5	-26	-21	-26	-9	+13	-11
CAR NO. 510 - OLD TIRES								
	80	16	82	175	66	133	50	
NEW TIRES								
	71	12	67	137	53	77	57	
% CHANGE								
	-11	-25	-18	-22	-20	-42	+14	-19

Fig. 5—Pedometer readings taken on two different cars disclose 11 and 19% reductions in body shake with the softer tires

corners or curves at high speeds.

Fourth gain the prospective new-tire user can expect is reduced rolling resistance. Tests on a 6.50 x 15 tire and on its 7.60 x 15 low-pressure replacement indicate a small but gratifying 4 to 6% reduction. See Fig. 6. These values include friction in the loaded power train aft of the transmission. But differences between the two curves are due entirely to change in tires. Tests gave similar results for all models, regardless of tire size, where the 15-in. wheel was previously used.

Rolling radius is a noteworthy feature when considering power requirements. The new 7.60 x 15 rotates 731 times per mile at very low speeds as against 754 revolutions for the older tires, as shown in Fig. 7. This partly explains the lower rolling resistance. Rolling radius increases with car speed (centrifugal force increases) so that

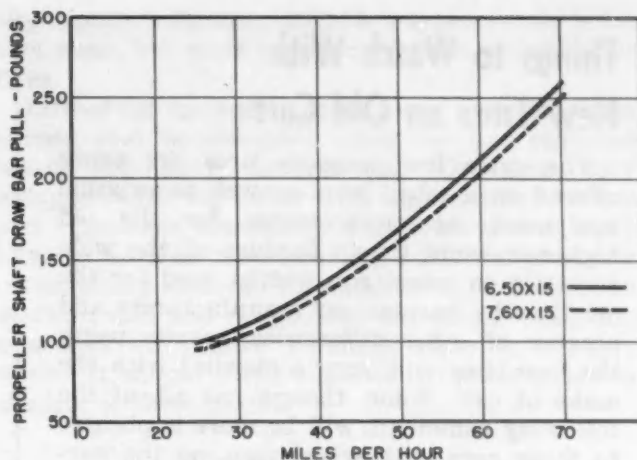


Fig. 6—Rolling resistance is 4 to 6% lower with extra low pressure tires

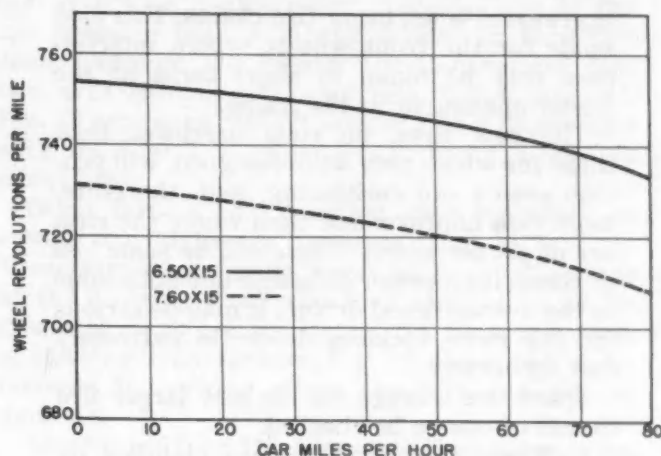


Fig. 7—Extra low pressure tires make fewer revolutions per mile than the tires they replace

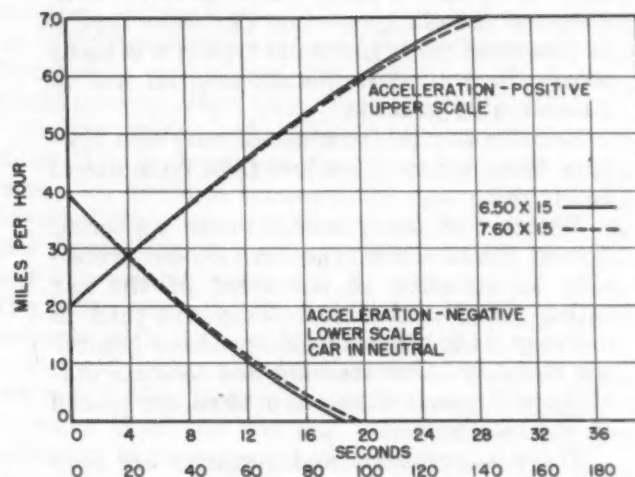


Fig. 8—Because of greater rolling radius, the softer tire makes for slightly reduced acceleration

Things to Watch With New Tires on Old Cars

The extra low pressure tires are being offered on a retail level as well as original equipment, as replacements for the old higher-pressure tires. Because of the wide variation in wheel rim widths used for the old tires by various car manufacturers and because of other differences, results using the new tires will vary somewhat with the make of car. Some, though not all, of the following comments will be more apt to those cars with wheel rims on the narrower side - rather than to those where wider rims were used. Here are several cautions:

1. *Where a complete set of the new tires is installed:* Some not too serious interference may exist in the rear wheelhouse under extreme conditions. It may be considerably aggravated when using tire chains. This also holds for the front wheels, where interference may be found in short turns, fender opening or at the frame.

The new tires, on rims narrower than those for which they were designed, provide even more cushioning, and, therefore, more ride improvement than where wider rims are of proper width. There will be some loss in cornering power; although not noticeable to the average good driver; it may be noticeable for the more reckless driver in extreme fast cornering.

Spare tire storage for the new tires should of course be checked.

2. *Where the new tires are installed on only two wheels:* First of all, installation should be made either on two front wheels or two rear wheels - not on one front and one rear (unless for brief periods only). The new tires have rolling radii greater than those of the old type when the older type is in new condition. If the old type tire is badly worn, the rolling radius differential will be considerably greater.

Benefits to ride from use of only two new-type tires will be much less than from use of four tires.

Because of the possible lower cornering power, the two new type tires should preferably be installed at the front of the car rather than at the rear. This will tend to increase understeering and produce greater car stability. Oversteering and less car stability will result if the new tires are placed on the rear only.

These suggestions and remarks are considered to be in accord with "good practice." Their violation will not necessarily prove serious.

wheel revolutions per mile are 708 and 733 for the new and old tires respectively, at 80 mph.

Bigger Tire Accelerates Slower

Greater rolling radius from switching to the new tires lowers car performance somewhat, if no other changes are made to the car. Acceleration is reduced, as shown in Fig. 8, so that the car takes an extra second or more to accelerate from 20 to 60 mph. These curves also show that the car in neutral will roll slightly farther - about 6 sec longer.

Both reduced rolling resistance and slightly lower engine speed add up to another soft tire

TIGHT BOUNDS

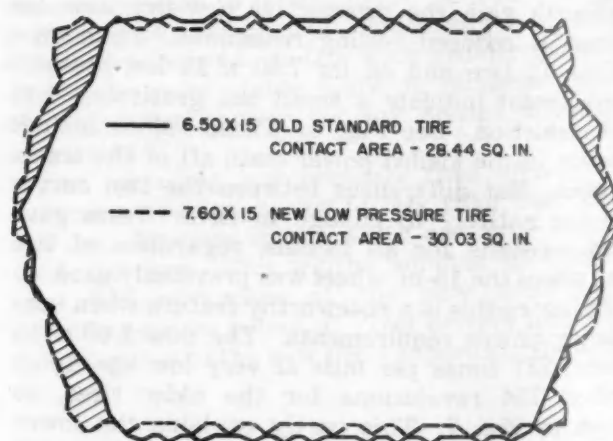
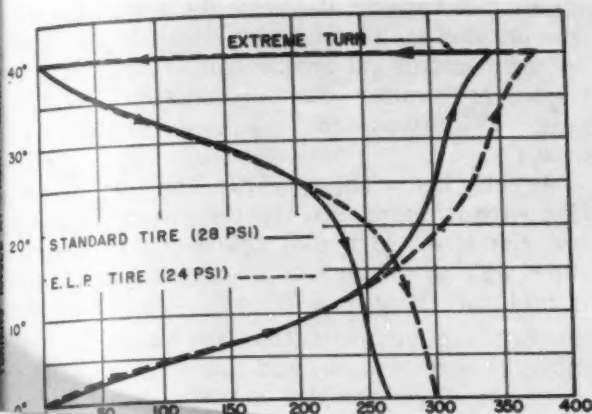


Fig. 10 - Ground contact patterns of old and new tires at 1000-lb load



slight underinflation results in a typical underinflation wear, but more pronounced than with the old tires.

Life of the car body and its many appurtenances should also be extended since the tire cushions wheel and body disturbances. On older cars equipped with the softer tires a good many rattles and vibrations disappear. Shock absorbers won't have to work so hard handling continual bouncing of unsprung masses. By eliminating smaller road disturbances and minimizing the larger ones, the new tires will relieve the shock absorber of much work. It should make significant improvement in the life of these parts.

The Price for Comfort

Liability side of the soft-tire ledger are steering and parking effort, blanketing and higher tire and wheel weight in squeal and performance loss mentioned. And steering effort when parked or in motion an unanticipated disadvantage of the new tire. Although weight on each tire change, the greater tire-to-pavement contact increases turning retardation moment. Compares contact area of 7.60 x 15 new tire to 3.50 x 15 counterpart under a 1000-lb load.

Factors held constant, steering effort on city and highways increases from 18 to 32%. Percentages seem large; but in actual pounds steering-wheel rim they amount to an increase of 3/4 to 1 1/4 lb. Data from tests on a form dynamometer, Fig. 11, shows noticeable increase in parking effort (no fore and aft car

relief from this steering-effort increase lies in overall steering ratio, a more efficient gear, decreased caster angle, and use of roller bearings at the king pin.

It is interesting to note that this same contact increase which boosts steering effort also produces a righting effect - straightening out of the

car after rounding a corner or curve. However, any decrease in caster angle to reduce steering effort would tend to offset this effect.

Brakes suffer somewhat, as expected, from blanketing by larger-section tires and wider wheel rims. An average temperature rise of 45 F was recorded when the old tires were replaced by the new ones. But this change is too small to make any appreciable difference in brake performance. The brake seems to function about the same in all respects with the new tires as with the old.

The wider rims also increase wheel weight. With the new 7.60 x 15 tire, the wheel weighs about 0.8 lb more than the old one. New wheel and tire assembly in this size weighs 49.7 lb, or 2.1 lb more than the old assembly.

Despite these small disadvantages, the new softer tire achieves an outstanding advance in car

level, making the new tires squeal more during cornering, according to some studies which showed that the older tires take corners about 9% faster, though both types produce equal tire noise intensity.

More Miles Per Tire

Another big selling point for the lower pressure tires from the cab driver's standpoint is longer tire life. Although there's not yet enough service experience for accurate comparisons, the softer tire with its greater enveloping power should be less subject to carcass damage. Tread wear rates also look better. Careful check of the new 6.70 x 15 size and its corresponding 6.00 x 16, with both tires having the same tread depth when new, show the new tire's tread will last 15% longer.

However, the new tires from a wear standpoint appear more sensitive to inflation pressures. A

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Both reduced rolling resistance and slightly lower engine speed add up to another soft tire asset - reduced fuel consumption. As shown in Fig. 9, there's a slight improvement, except at higher speeds.

Fig. 4 shows up another fuel-saving source. Maintaining a disturbance of unsprung masses, such as those in the curves, consumes some energy. If a car drove over a road at 30 mph with all car

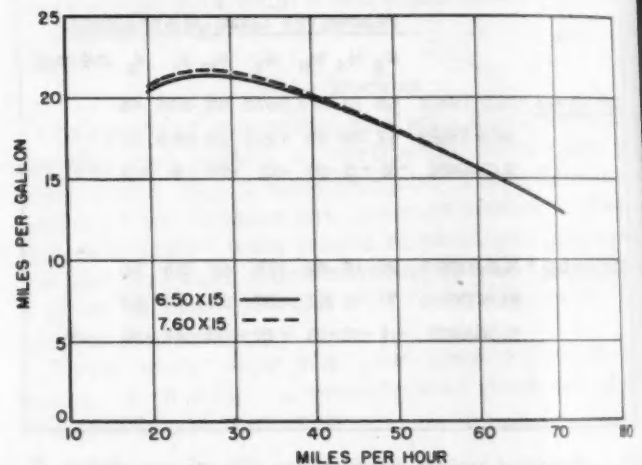


Fig. 9 - More miles per gallon of gasoline seem to be in store for cars riding on extra low pressure tires due to reduced rolling resistance and slight decrease in engine speed

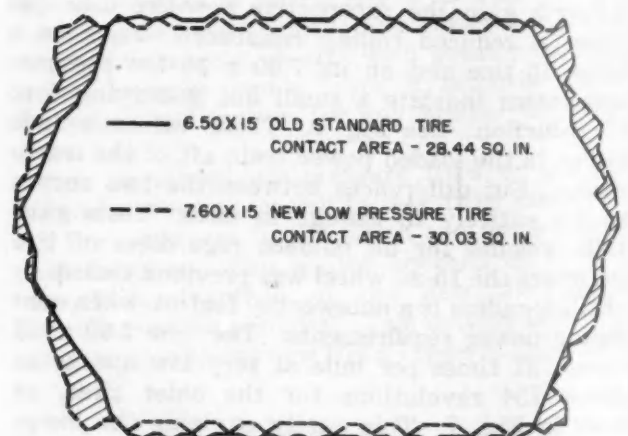


Fig. 10 - Ground contact patterns of old and new tires at 1000-lb load

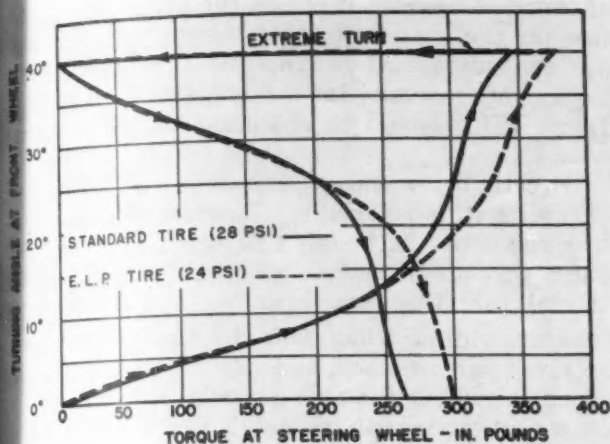


Fig. 11—New tires will make the driver work a little harder on the steering wheel when parking

wheels striking 1-in. cleats at about 14-ft intervals (as on the rolls) with wheel travel shown by the curves, power would be required to: furnish vertical wheel accelerations, deflect the car springs, and overcome shock-absorber resistance and chassis resistance. All this amounts to something like 2.1 hp for the old tires against only 1.3 hp for the low pressure type. Thus the soft tires should also yield a small improvement in rough-road fuel economy.

Lower pressure tires derive a fifth benefit, better flotation. Reason: they produce greater tire-to-ground contact area (see Fig. 10) so that unit ground pressure is lower. Our experience indicates lower tire pressures, down to a certain minimum, produce some gain over sand and dry snow. There seems to be little improvement for mud and wet snow.

The new tires are quieter in straight driving, but slightly noisier in taking corners. They make 4% less road noise than conventional tires. However, inflating the new tires to old-tire pressures nullifies this gain. The new tires squeal more during cornering, according to some studies which showed that the older tires take corners about 9% faster, though both types produce equal tire noise intensity.

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On the liability side of the soft-tire ledger are increased steering and parking effort, blanketing of brakes, and higher tire and wheel weight in addition to squeal and performance loss mentioned.

Increased steering effort when parked or in motion is not an unanticipated disadvantage of the low pressure tire. Although weight on each tire doesn't change, the greater tire-to-pavement contact area increases turning retardation moment. Fig. 10 compares contact area of 7.60 x 15 new tire with its 6.50 x 15 counterpart under a 1000-lb wheel load.

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ride improvement if its inflation pressure and load limitations are not exceeded.

(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

WHAT THEY ARE... SHIVELY

continued from page 23

they clearly show that the larger tires are new and different.

The standard 15-in. wheel program economizes and simplifies all along the line. In lighter cars, the 1-in. smaller diameter wheel - reduced from 16 to 15 in. - saves weight and reduces cost. It helps offset the slightly-higher tire and tube costs. The change also maintains rolling radius of conventional type tires on lighter cars so that power performance is maintained without changing gear ratios.

Interchangeability of extra low pressure tires on all existing rims of permissible width is a desirable and practical feature. This new tire has been designed to fit properly and to be interchangeable on both the old E-F flange-type rims and the new K-L types, where permissible widths are used.

New Tire Branding

Branding on extra low pressure tires differs from that on conventional tires to insure proper use and to avoid confusion. Fig. 2 shows a typical branding for the softer tires. It's different from the old way

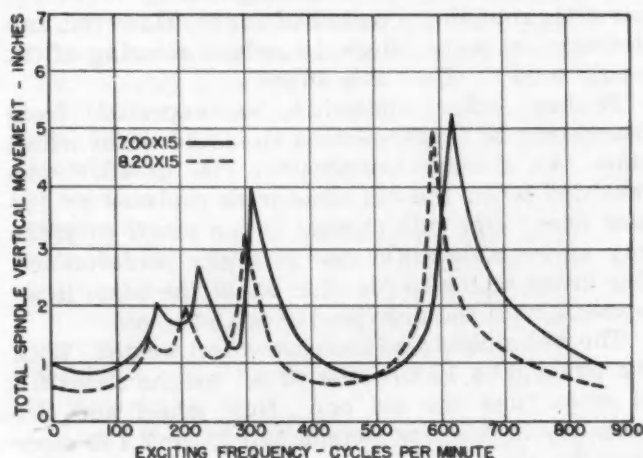


Fig. 2 - How one manufacturer is branding the new extra low pressure tires

of doing it because it shows the actual size of the tire on the standard recommended rim. It uses different numerical designations to prevent substitution of similar dimensional-size conventional tires. (This would be objectionable performance-wise.)

Directly below the size branding, and in conjunction with it, is marked the recommended or standard rim size. Although this won't be shown the same way on all makes, all manufacturers will do it and for these two reasons: (1) to show the standard rim on which this tire size will give best balanced performance, and (2) to indicate the rim width on which the tire actually measures up to cross-sectional width indicated by the name size.

Proper size of conventional tube that can be used with the extra low pressure tire is shown on the tire directly below the ply branding. See Fig. 2. This will be useful until double-branded tubes are generally available. The tire branding also shows size of conventional tire replaced by the proper new one to minimize misunderstanding until tire dealers are properly educated.

All these steps were taken to ease the new extra low pressure tire line into the market with as little transitional difficulties as possible for car designer as well as car owner. The car engineer should also find his problems minimized since use of the softer tires on present or new models requires no basic design changes. Of course each car manufacturer must make his own decision in detail to best meet his own conception of satisfactory tire clearance and general performance standards.

Adapting Car to Soft Tires

In some instances, for example, the wider rims may require slight modifications of certain steering system parts. And spare-tire carriers may have to be altered, too.

Minor front-end adjustments also may prove beneficial in some cases to get the type of steering desired. The soft tire's greater enveloping power may be fully exploited by rebalancing springs and shock absorbers for best overall ride characteristics. This isn't a must, but may give added ride improvement.

Replacing the 16-in. diameter tire with the new 15-in. type doesn't affect gear ratios or speedometer adjustments. Where the 15-in. diameter is retained, the new type tires make for a 3 to 5% change in ratio.

There's nothing sacred about rim widths established as standard and recommended for each size of extra low pressure tire; but they are considered optimum for best all-around performance. Narrower rims will improve ride slightly, but at the cost of reduced cornering power or stability, faster tread wear, worse irregular front-tire wear, and increased possibility of fatigue failure in the tire bead area. Wider-than-recommended rims will in-

Concluded on page 54



Fig. 1 - Difference in speed between body and chassis lines permits the body to be laced over the steering column

PLYMOUTH'S Unique Conveyors

EXCERPTS FROM A PAPER* BY

John vonRosen

Plant Engineer, Plymouth Division, Chrysler Corp.

PLYMOUTH'S Detroit plant uses conventional conveyors in unusual ways. Particularly interesting are those in the actual automobile assembly line.

Even prior to wedding of body to chassis, shown in Fig. 1, a number of ingenious conveyors transport the chassis through its assembly growth processes.

Assembly of the Plymouth begins with the frame which, when received from the vendor, is placed on a monorail conveyor that travels up and over

the roof of the plant and ducks down into the building at the point where the assembly line begins. As this conveyor travels over the roof, it goes through a housing or chamber equipped with steam jets and an air blow-off for a cleaning and de-icing of the frames when necessary.

The actual automobile assembly begins here and is broken into four principal units - the frame assembly, chassis assembly, body assembly, and final assembly - each with a type of conveyor suited to the particular work involved.

Frame Becomes Chassis

First unit of the integrated assembly line is the frame assembly conveyor which moves with an intermittent motion and carries the work along at about bench height. Most operations on this conveyor are performed with the frame in an inverted position. As the frame approaches the end of this

*Paper "Material Handling - Conveyors," was presented at SAE National Production Meeting, Cleveland, Oct. 20, 1947.

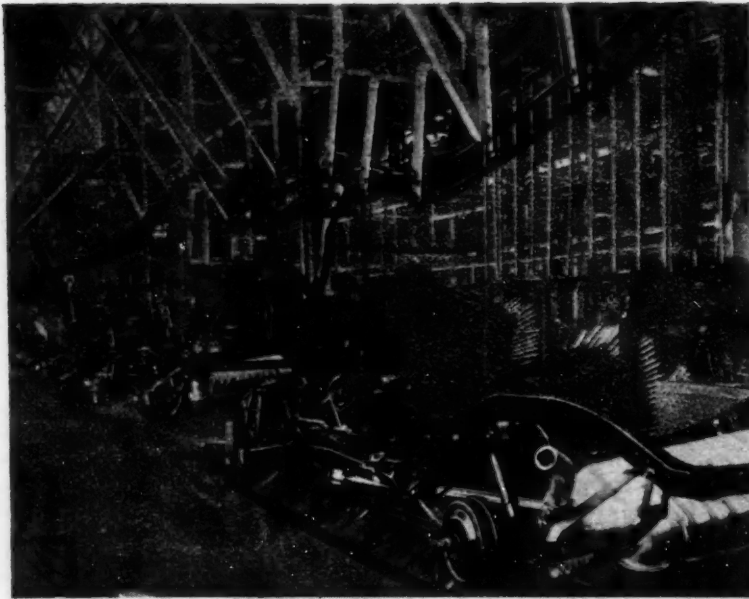


Fig. 2—Hooks from an overhead conveyor grab the frame as it moves into the chassis assembly line

conveyor, it is turned over by a special turnover hook used in conjunction with an electric hoist, and placed back on the conveyor right side up. The frame is then automatically transferred to the overhead monorail chassis conveyor.

The transfer is made automatically by a special cam track and flanged roller wheels that bring the front and rear hooks (which suspend the frame from the overhead conveyor) into position for automatically lifting it from the frame conveyor. That's the reason for intermittent instead of continuous motion of the bench-type frame conveyor.

Last station on this conveyor is the locating or positioning station that permits the hooks from the overhead chassis conveyor to engage properly. Fig. 2 shows this positioning station and the engaging of the hooks for the overhead chassis conveyor.

Several good reasons are apparent for using an overhead conveyor on the chassis assembly line. Principal operations performed on this chassis assembly are installation of brake tubing, chassis painting and drying, assembly of the wheels, and hydraulic brake bleeding. Suspending the chassis from an overhead conveyor gives the worker accessibility and freedom of movement for installing tubing and clips and for other miscellaneous operations. It also allows movement through the conveyor with small items of stock.

Tidy Painting

Painting the chassis on a floor or bench-type conveyor has always created a mess and a nasty maintenance problem since the sticky black chassis paint gums up the conveyor chain, track, and wheels; this stiffens the chain and requires excessive pull or load on the conveyor drive. It leads to many maintenance difficulties as well as the job of periodically cleaning the assembly chain.

By suspending the chassis from an overhead

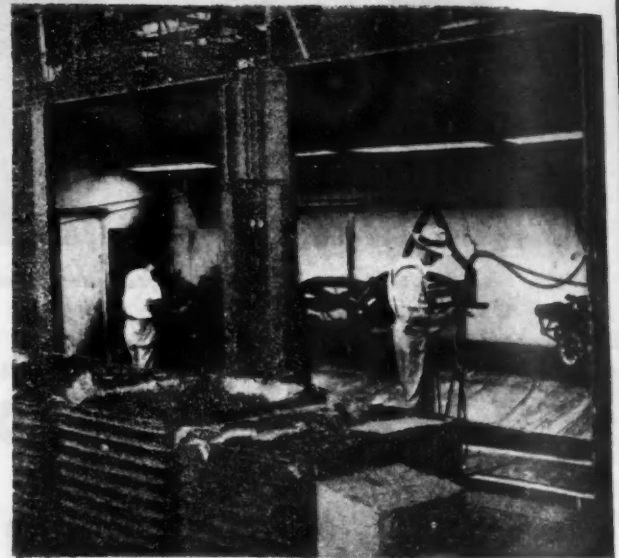


Fig. 3—Suspending the chassis from an overhead conveyor during painting eliminates messed-up chains and trolleys

conveyor, Fig. 3, these difficulties are not encountered because the chain and trolleys are up out of the way and not in the path of the paint spray. It also gives the operator a clear shot at the underside of the chassis so that a better quality and more complete job can be done in chassis painting.

It's true that a certain amount of paint gets on the hooks where they engage the chassis; but this is not troublesome and only a "drop in the bucket" compared to the paint which gets on the chain and conveyor framework if a floor-type conveyor is used. When the chassis emerges from the drying oven, the wheels are assembled.

How Wheels Are Made

Wheels are received from the tire and wheel department where the front brake drum, bearing, bearing retainer, and tire are assembled to the wheel. There is a unique device for performing these operations in the wheel department, which consists of a large turntable or merry-go-round

conveyor with 14 individually-powered rotating work spindles. The spindles are alternated for front and for rear-wheel assembly.

In the case of the front-wheel assembly, the bearing, bearing retainer, and front hub are placed on the spindle at the loading point. The operator then actuates an air valve which, by means of a small air cylinder, presses in the bearing retainer. The merry-go-round conveyor moves continuously. As the spindle passes a certain location, it trips a mechanism which automatically injects a measured quantity of grease, under pressure, into the front-wheel bearing. The wheel bolts are started by hand and then driven home with a high-cycle tool.

The tire and tube assembly, fed to the merry-go-round conveyor by an overhead monorail, is then placed on the wheel. See Fig. 4. A long arm suspended from a column in the center of the turntable is equipped with a steel roller which rolls the tire onto the wheel. The operator does this by stepping on a foot switch which actuates a small gear head motor, which drives the spindle. Next the tire is inflated by attaching an air hose, which is set at a specified air pressure.

After inflation, the assembly moves to a station where it is automatically unloaded from the turntable onto a short section of roller conveyor. It is then dropped into a sling-type hook suspended from a monorail conveyor, which carries the wheels according to a predetermined schedule over to the assembly line where they are automatically dumped into a chute, shown in Fig. 5, which feeds the assembly line.

Right-hand wheels dump into a chute on the right side of the assembly line, left-hand wheels dump into a chute on the left side of the assembly line. It's done by carefully spaced lugs on the bottom of the sling hooks which are actuated by fixed rollers which cause the proper wheel to dump into the proper chute.

After the wheels have been assembled to it, the

chassis goes through the brake bleeding setup. Brake fluid, under pressure, is forced through the hydraulic brake system and drains into sheet metal troughs underneath the conveyor, to assure the expelling of all air in the brake system. The fluid drains from the troughs into a tank set in the floor. From this tank, it is pumped through filters and back to the central supply.

Next feature of unusual interest on the assembly line is the point where the chassis is automatically released from the overhead conveyor onto the final assembly line—a moving plate-type of conveyor, flush with the floor. The hooks are released by extended pins from the shank of the chassis carriers which drag on a flat cam track. The overhead monorail dips down, placing the chassis on the plate conveyor. Friction drag of the extended pins on the cam track causes the hooks to back away from the chassis until a rise in the monorail conveyor, shown in Fig. 6, carries them clear.

Chassis Takes on Engine

First principal operation on the final assembly conveyor is the dropping of the powerplant assembly into the chassis. The conventional method of accomplishing this operation is to deliver the powerplant assembly to the line by conveyor and to drop it into the chassis with an electric hoist and tramrail arrangement.

At Plymouth the engine is set into the chassis directly from the overhead monorail conveyor. See Fig. 7. This calls for accurate timing in setting of the engine and release of the engine hook. It's done by putting a converter and d-c motor on the drive of the powerplant delivery conveyor. An operator controls the timing and speed of engine drop by a rheostat controller, very similar to the type used by a streetcar motorman.

As the chassis assembly continues down the line, it meets the body, which has been carried by special overhead conveyor across the plant on a line

Fig. 4—Tires with tubes on this merry-go-round conveyor are joined to the wheel by an arm extending from the column centered on the turntable



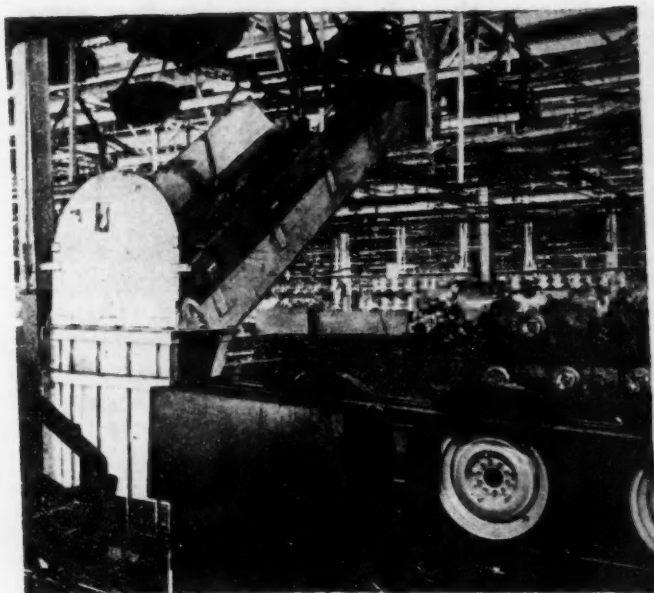
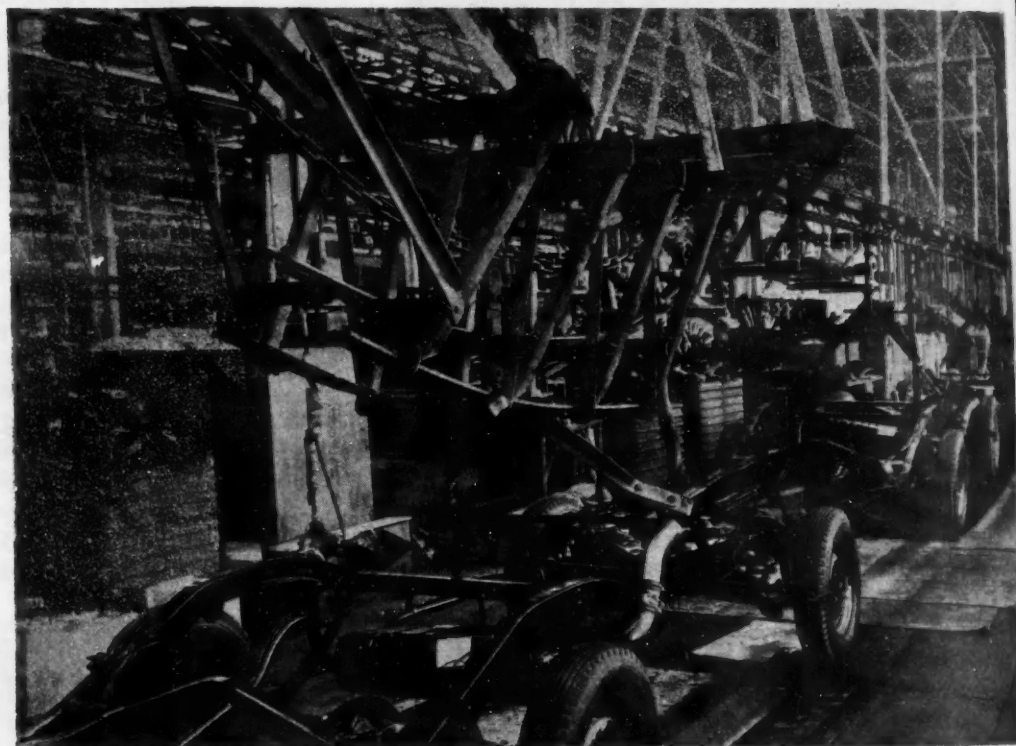


Fig. 5—This chute directs the tire-and-wheel assembly to the assembly line. The monorail conveyor above the chute is designed to separate right-hand from left-hand wheels and to dump them in the proper chute

Fig. 6—At this point in the assembly line the chassis is transferred from the overhead to a moving plate conveyor. The overhead hooks back away from the chassis and are carried away over a rise in the monorail overhead



that is at right angles to the final assembly line. At the Plymouth Plant bodies completely painted and trimmed are received from the body shop on long trailers which carry eight bodies to a load.

Tricky Body-Chassis Assembly

The body is set on the chassis directly from the overhead conveyor in much the same manner that the powerplant assembly is set into the chassis. The overhead body assembly line also is powered by a d-c motor controlled by an operator with a rheostat controller. The overhead body line and the floor-type final assembly line cannot move at a synchronous speed since the steering column has

been assembled to the chassis; the body must be placed over this steering column through the floor board hole by lagging the body on the overhead conveyor, slightly behind the chassis on the floor-type conveyor, until such time as the body has moved in over the steering column. Then the overhead body line must be accelerated to catch up with the chassis on the floor conveyor.

By means of a series of cam tracks, outriggers, and switches, the rear end of the body is let down first while it is guided into position over the rear body studs. The front end then lets down, as in Fig. 1. During this operation, the clearance between the radiator core (which is part of the unit

Fig. 7 - Lowering engine on chassis without an electric hoist, as at Plymouth, calls for precise timing

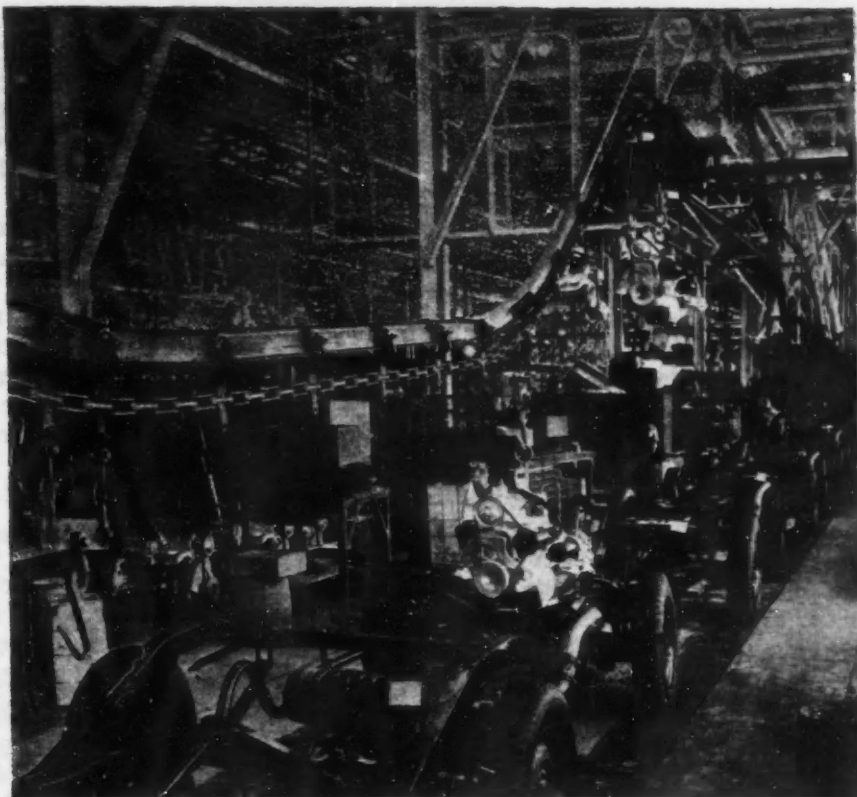
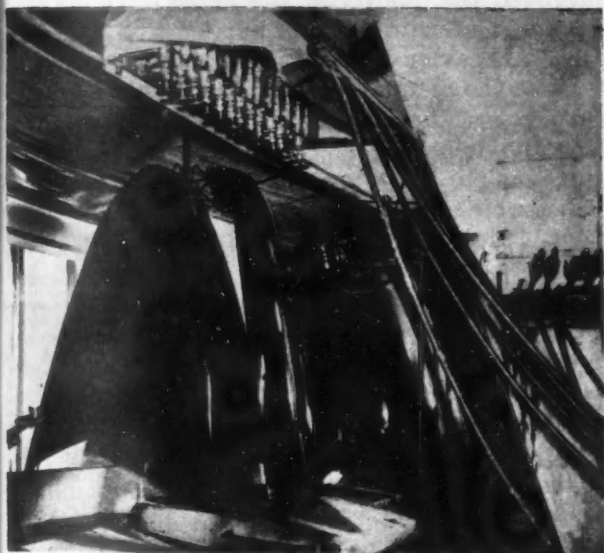


Fig. 8 - A moving spray gun automatically paints a trio of hoods as they spin, suspended from an overhead monorail conveyor. Idea for this operation was borrowed from the pottery industry



is scheduled to the line on an overhead monorail conveyor.

Hood Painting Solved

The Plymouth Plant has a setup that paints hoods, fenders, and other sheet metal parts automatically instead of manually. Advent of the one-piece alligator type hood brought forth this unique method of applying the finish coat to the sheet metal. It could be foreseen that the application of the color coat on a large piece of sheet metal, such as a one-piece hood, by a manually-operated spray gun would be a difficult and fatiguing process for the operator.

Considerable experimenting was done to develop a method to apply automatically this finish coat to the hood tops. Many ideas were sketched on the board, but were rejected one by one as being too costly, too cumbersome, or too complicated. It was then decided to investigate some other industry completely divorced from the automobile industry which might have a process or application, tried and proved, which would solve the problem.

The pottery or dish-making industry had been spraying glaze automatically on vases, cups and saucers, and dishes very successfully for a great number of years. They do it with a fixed spray gun and rotating work. An automobile hood was a far cry from a cup or a saucer. What was it that made automatic glazing in the pottery industry a comparatively simple task?

All their ware or objects to be glazed are simple geometric shapes. An automobile hood, obviously,

body assembly) and the front of the fan pulley on the powerplant assembly in the chassis is only about $\frac{1}{4}$ in. However, the radiator and the front end sheet metal have been assembled to the body on a jig. The rear end of the body has been set down on the chassis over the rear body studs.

Since these rear body studs act as a hinge when the front end lets down, the same $\frac{1}{4}$ -in. clearance is always maintained and there are no casualties. The body hooks are disengaged, the overhead monorail conveyor rises, and completes the loop circuit to the start of the body line. The work continues down the assembly line, receiving its quota of additional parts, including the hood which

is not a simple geometric shape. But three hoods grouped on a spindle become an almost perfect truncated cone. Progress was fairly rapid after introduction of this idea. The simplest thing then would be to spray this group of hoods with a gang of fixed overlapping spray guns. Many different colors to spray, however, made this impractical as too much time would be lost in changing or cleaning a whole battery of guns when changing colors. The next development was a moving spray gun holder traveling on a track, parallel to the side of the cone formed by the three hoods.

The base of the cone contained a far greater area to be coated per linear inch of height than the tip of the cone. This presented a new problem. As the gun traveled upward, this area per lineal inch constantly decreased. A uniformly accelerated up-stroke and decelerated down-stroke of the spray gun was gotten with a cam which constantly varied the pitch of a variable pitch sheave, incorporated in the drive that powered the spray gun motion.

Next was the development of a cam track and arm which would enable the gun to move in and out while it followed the contour of the work on the spindle. To paint the top of the truncated cone, it was necessary for the gun to ride out over the tops of the hoods and to also tilt down, so that the direction of the spray was always normal to the surface to be coated. This was accomplished by a second cam track with roller and linkage.

How It Works

Briefly, these are the automatic painting operations: After metal assembly in the white and metal finishing, the parts are rustproofed, then prime-coated by automatic dip tank method, baked, scuffed, and spot-sanded, and loaded on the spindles which carry the work into the automatic spray room for application of the finish coat.

Two color coats are applied and then the work goes through the final drying oven. The work-holding spindles move on an overhead monorail conveyor, which travels with intermittent motion. The work moves into the spraying station and stops. The spindle starts to spin. It is spun by a split flat face pulley on top of the spindle which comes in contact with a small rotating endless belt with a fixed spring tension, located at the spraying station.

As the moving gun on the paint-spraying machine comes even with the bottom edge of the spinning work, the paint automatically starts to spray. The gun travels up and outward, following the contour of the work and tilting when necessary so that it is always normal to the surface being sprayed. At the end of the painting cycle, the gun automatically cuts off.

The work automatically moves to an intermediate station, bringing the next spindle into the painting station. The moving spray gun has by

this time started its downward movement. As it comes even with the top of the work, it automatically cuts on, goes through its spraying cycle, and automatically cuts off when it has passed the bottom edge of the work. In other words, one spindle is painted on the up stroke and the next spindle is painted on the down stroke.

The work leaves the first coat painting station and goes to an intermediate station where the spray coating has an opportunity to set for approximately 1 min. It then moves into the second coat spray station, where the painting operation is repeated. From there the spindle is carried on the same conveyor through a large floor-type drying oven where it receives its final bake.

Operator's Job Simple

The work of the operator has been cut to a minimum; his principal duty is merely that of changing the gun when it is necessary to spray a different color. He does this by backing off a wing nut, removing the gun, replacing it with a different gun, and again assembling the wing nut. Likewise, the air hose must be removed from the gun and assembled to the other spray gun.

This automatic spray painting application has improved the quality of the finish since the same thickness of paint film is applied over the entire part. A heavier application of paint can be made because the manual element has been taken out of the process, thereby eliminating the possibility of sags and drips.

(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Just Off the Press . . .

- A revised Check List of SAE meetings papers and special publications is available free of charge to anyone interested in sending for it.
- One hundred and thirty SAE meetings papers, presented during the past 12 months before National and Section Meetings, and 28 special publications are listed, showing prices to SAE members and non-members.
- Request your copy from the Special Publications Department, Society of Automotive Engineers, 29 West 39th St., New York 18, N. Y., and you will receive it in the return mail.

FIELD TESTS

Aid DIESEL FUELS STUDY

BASED ON A PAPER* BY

W. F. Joachim, W. E. Robbins,
M. S. Gordon, and T. G. Timberlake
U. S. Naval Engineering Experiment Station

(This paper will be published in full in SAE Quarterly Transactions)

EXTENSIVE tests on 89 heavy-duty lubricating oils submitted to the Naval Engineering Experiment Station during the period 1940-1946 by 28 oil companies has convinced the authors that no physical, chemical, or bench tests can serve as substitutes for full-scale, service tests in rating oils for the effectiveness of their detergent properties in Naval diesel engines.

Consequently, in addition to the physical, chemical, and bench tests, small engine and also multi-cylinder, service-type submarine engine tests were used with these oils, of which only 20 were finally approved. A complete report of the entire testing program will be published in full in SAE Quarterly Transactions.

In order to compare oils and to correlate their relative detergency characteristics, the authors explain that an "average weighted cleanliness rating" was devised. They determine the influence of crude oil source, manufacturing process, additive classification, additive metal concentration, and residual oil content of the base oil on the average weighted cleanliness ratings. The authors conclude that all of these factors appear to have an influence on the cleanliness of diesel engines.

The ratings of oils approved each year from 1940 to 1946 indicate definite progress in the improvement of the detergency characteristics of the oil, the authors say, but they feel that further improvement is desirable, adding that outstanding results by some suppliers indicate that such further progress in this direction is feasible.

Conclusions

Conclusions reached by the authors include:

1. Based on 64 oils tested in one to three deter-

gent-sensitive engines, crude oil source, manufacturing process, and type of detergent additive have approximately average influences on the detergent properties of heavy-duty lubricating oils, ranging from minimum to maximum average weighted cleanliness ratings of 141 to 313, 157 to 375, and 62 to 802, respectively; resulting in relative average influences between crude source, manufacturing process and additive of 4, 5, and 17, respectively.

2. Increase in concentration of additive metal or metals, expressed as total milliequivalents per liter, based on 39 oils tested in all three detergent-sensitive engines, generally increased the detergent effectiveness of heavy-duty oils, resulting in a reduction of maximum average weighted cleanliness ratings from approximately 400 to 150 between 20 and 60 milliequivalents per liter.

3. Increase in percentage of residual blending stocks, selected, among other reasons, to produce oils meeting physical and chemical specifications, generally reduced maximum average weighted cleanliness ratings from about 280 to 180 between 5 and 58% residual for 20 oils containing residual and tested in all three detergent-sensitive engines.

4. The oil industry has made commendable progress in improving the detergency of heavy-duty lubricating oils as shown by the reduction in average weighted cleanliness ratings of approved oils from 204 in 1940 to 107 in 1946.

5. The production of a heavy-duty lubricating oil having high detergent effectiveness by one refiner in 1945, as shown by the low average weighted cleanliness rating of 43, is considered outstanding.

6. Further improvement in heavy-duty lubricating oils should be directed toward increased detergency further to minimize or eliminate the following factors in the order listed: port clogging, piston-skirt deposits, piston-ring sticking, piston-ring-land deposits, piston-ring-groove deposits, cylinder-liner lacquer, and oil system sludge.

(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

*"Experience with Diesel Lubricating Oils" was presented at the SAE National Fuels & Lubricants Meeting, Tulsa, Nov. 6, 1947.

Four Current AUTOMATIC Transmissions—How They Work

BASED ON PAPER* BY **L. H. Nagler**

ONLY similarity among the four major types of automatic transmissions, shown at right, is that they reduce driving effort required to get the car under way (see Fig. 1) and permit normal forward car operation without touching the gear shift lever.



Fig. 1—To get a conventional car under way, the driver must go through these 15 steps. With at least two of the automatic transmissions in production, he can do it in three—steps 1, 13, and 15

But there the resemblance ends. Four different shift patterns, for example, are used for the direction control lever on the steering column. Two (the Hydra-Matic and Dynaflo) permit shifting under engine power, while Chrysler's Fluid Drive and Hudson's Drive Master shift only when power flow is interrupted.

For gradual application of power at low car and engine speeds, both the Fluid Drive and Hydra-Matic use a fluid coupling. In the Drive Master it's done with a vacuum-operated clutch, in the Dynaflo by a hydraulic torque converter. These and other main features of each design are shown in Table 1.

Now let's examine each of these four "self-shifters" in greater detail.

Hudson Drive Master

The Hudson Drive Master is basically the conventional synchromesh transmission with a vacuum cylinder and piston arrangement to operate the clutch manually, and a second vacuum cylinder to actuate the 2-3 shifter lever. A connection to the accelerator pedal triggers the clutch release and a governor restricts the speed ranges within which shifting and automatic clutch action takes place.

With this design normal starts are made in 2nd. The transmission shifts to 3rd above a 13-mph minimum speed, whenever the accelerator pedal is momentarily released. Downshift to 2nd is possible for increased acceleration by flipping the manual lever to the 2nd gear position. An automatic overdrive, frequently installed back of the Drive Master, gives the effect of a three-speed automatic transmission plus a wide variety of ratios and controls—ranging from conventional drive to full automatic.

The Fluid Drive

Chrysler's Fluid Drive consists of a four-speed, two-range gearbox mounted behind a fluid coupling and a conventional foot clutch. The foot clutch is needed for shifting from neutral to high or low

*Paper "Transmissions that Shift for Themselves," was presented by L. H. Nagler, automotive writer and technical consultant, at SAE Metropolitan Section, New York, Jan. 21, 1948.

Transmissions

range; but after that all normal driving can be done without touching either gearshift lever or clutch pedal.

In high range starts are made in 3rd. The driver shifts to 4th above a fixed minimum speed by merely releasing the accelerator pedal. Then a free-wheeling device in the transmission releases the drive in 3rd and a hydraulic arrangement shifts the drive in 3rd and a hydraulic arrangement shifts to 4th speed.

When in 4th, a "kick-down" shift to 3rd is made by depressing the accelerator pedal all the way down. A special switch interrupts the ignition circuit for a few explosions, momentarily breaking power flow and gear loading. Hydraulic actuation then completes the shift into free-wheeling 3rd. The same major transmission elements are used in 1st and 2nd gears and similar automatic shifts can be effected in low range.

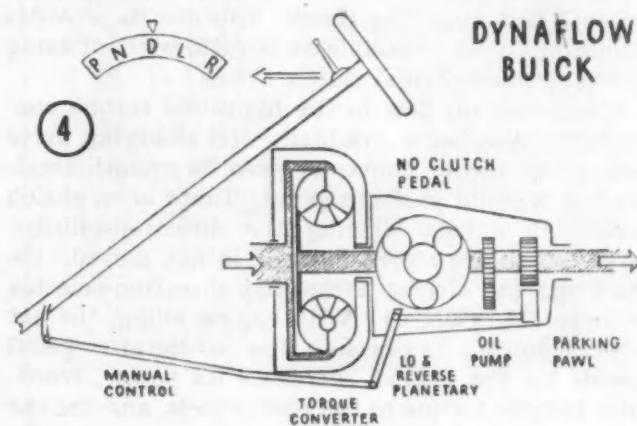
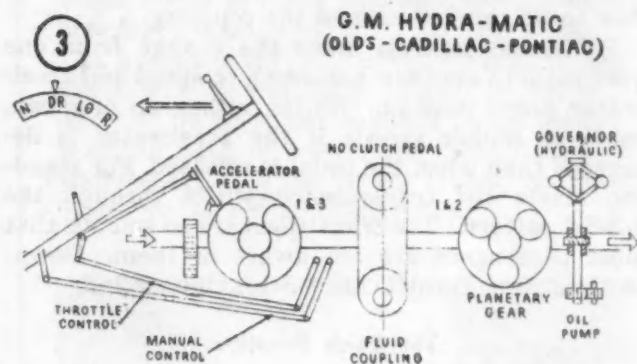
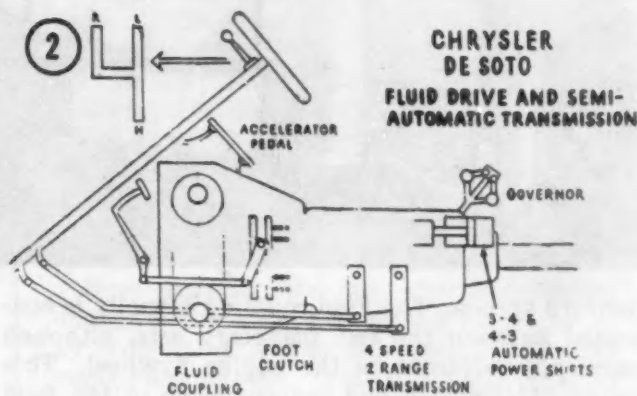
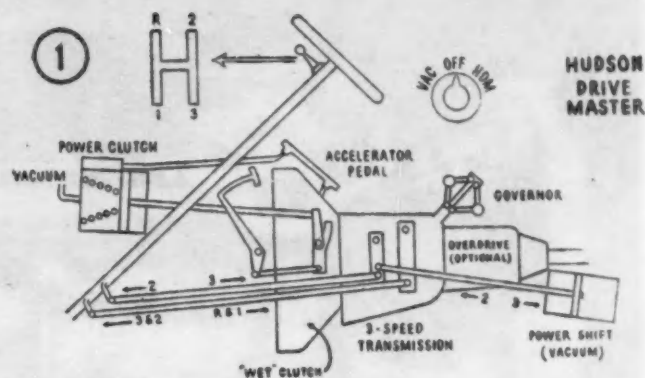
Starting in next-to-top gear is more effective in this type of transmission than with a conventional one because the fluid coupling allows the engine to come up to a speed approaching that for maximum torque when the throttle is opened. This reduces stalling possibility and also develops ample torque for acceptable acceleration. It eliminates problems accompanying engine operation under full power at low speeds.

General Motors' Hydra-Matic

The Hydra-Matic - in the Oldsmobile, Cadillac, and now the Pontiac - does away with the conventional foot clutch by using a fluid coupling and frictional pick-up of the gears. Two sets of planetary gears, arranged in series, make possible four

Table 1 - Automatic Transmission Characteristics

	Drive Master	Fluid Drive	Hydra-Matic	Dynaflow
Ratio Steps (Automatic)	2	2	4	Infinite
Ratio Coverage (Automatic)	1.62	1.75	3.82	2.25
Shifting Under Power	No	No	Yes	Yes
Type Hand Control	H	Modified H	Progressive	Progressive
Type Automatic Control	Vacuum-Electric	Hydraulic	Hydraulic	Torque Converter
Governor	Yes	Yes	Yes	No
Fluid Coupling	No	Yes	Yes	Yes
Foot Clutch	No	Yes	No	No
Type Reverse	Gear	Gear	Pawl	Band
Parking Brake	Engine Compression	No	Reverse Position	Yes
Emergency Low	Yes	Yes	Yes	Yes
Idle Ratio Decreased	O-D	0.17-0.55	0.41-0.88	0.20



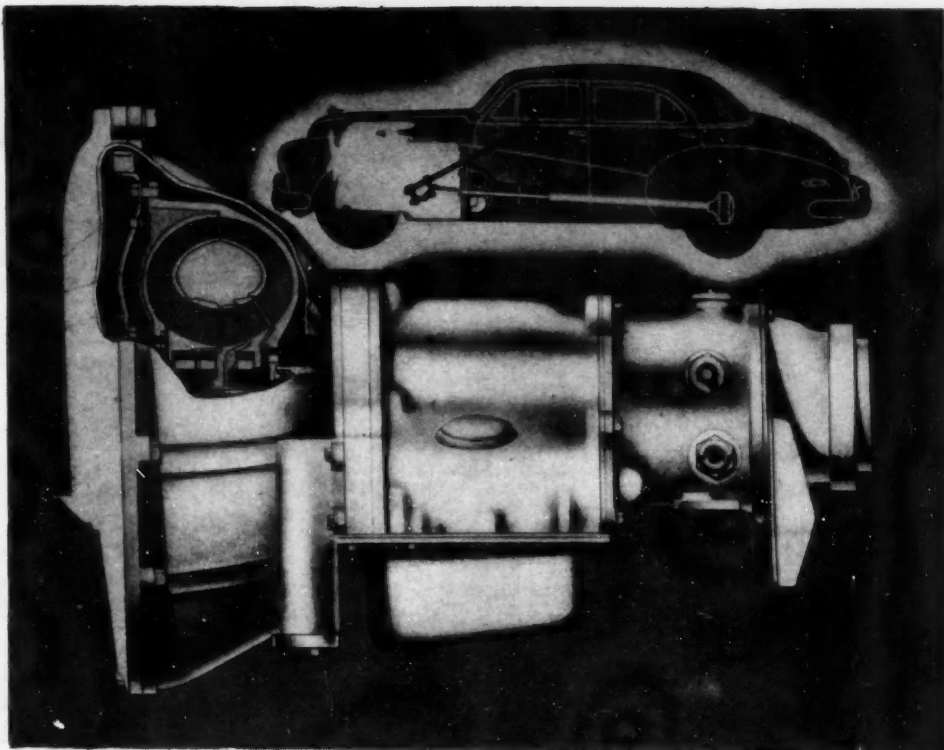


Fig. 2 - A cutaway view of Buick's Dynaflow transmission. The entire transmission package, containing torque converter and planetary gears, is mounted on the rear of the engine

forward speeds. The fluid coupling actually is connected between the two planetary sets, although physically adjacent to the engine flywheel. This increases efficiency and reduces some of the fluid coupling's shortcomings when it's always operated at engine speed. It also allows some of the power flow to be shunted around the coupling.

Hydraulic controls make the change from one gear ratio to another, according to speed and accelerator pedal position. Shifts, either up or down, come at higher speeds if the accelerator is depressed than when the pedal is released. For standing starts the transmission shifts through the 1-2-3-4 pattern. The transitions are so smooth that most passengers are not aware of them. Downshifts at zero throttle are 4-3-1, skipping 2nd.

The Buick Dynaflow

The torque converter made its first appearance on an American car in the Dynaflow transmission, recently announced by Buick. This design provides an automatically variable drive ratio without using gears or conventional clutch.

Controlled oil flow in the hydraulic torque converter makes for a gradually self-changing drive ratio. The torque converter permits smooth acceleration without shifting gears. There is no clutch pedal. In normal driving the direction-selector lever under the steering wheel is not moved. On starting, the driver flicks the direction-selector lever to "D" (Drive). With engine idling, the car doesn't move. Depressing the accelerator pedal speeds up the engine, increases its power, transmits greater torque to the rear wheels, and the car moves off. Greater pedal depression speeds up the

engine and also increases acceleration.

Under normal conditions, engine speed is equivalent to direct drive. The operator gets increased power for pickup or hill climbing under 50 mph by stepping down on the accelerator pedal. This speeds up the engine; the converter adjusts itself to a suitably higher drive ratio, and increased torque flows to the rear wheels.

Absence of gear shifting makes changes in ratio perfectly smooth - reminiscent of old-time steam cars controlled entirely by the throttle.

In addition to D (Drive), other positions on the direction-selector switch are N (Neutral), R (Reverse), P (Parking), and L (Emergency Low). The latter also may be used for downhill braking and for emergency power on steep hills, in sand, or in mud.

The complete Dynaflow transmission, shown in Fig. 2, is essentially a hydraulic torque converter in front of a hydraulically-applied two-speed-and-reverse planetary gear transmission. Both reverse and low have positive gear ratios of 1.82:1. Direct drive is used almost exclusively for forward driving. The torque converter gives additional reduction in drive, low, and reverse.

Torque ratio of the converter unit at standstill is about 2¼:1. As the car starts off, the ratio drops through an infinite number of steps to nearly 1:1. That's why the mechanism is called an infinitely variable ratio transmission.

The converter provides the hydraulic equivalent of a mechanical gear transmission, but is not limited in available ratios like the geared arrangement.

The torque converter looks something like a

fluid coupling. Main difference is that the converter increases engine torque; the coupling merely transmits torque without any increase or decrease, but with slight loss in speed.

Present indications point to the torque converter as the automatic transmission of the immediate future, although step-ratio jobs are by no means ruled out. More experience, particularly in production and service, can bring down its cost. Past and present designs have made notable contributions to our automatic transmission know-how. Perhaps 97% of this knowledge consists of how not to build one. Since no one transmission can be superior in every respect, the problem boils down to a compromise. Future transmissions probably will emphasize increased efficiency, improved performance, and reduced manufacturing costs.

Why Automatic Transmissions Cost More

The public must pay in two ways for wanting to avoid use of clutch pedal and shift controls, claims discussor Stuart P. Hall, of Product Engineering. First, automatic transmissions cost more to make. Second, they consume more fuel.

Today conventional synchro-mesh car transmissions are produced for \$20 to \$30. Automatic transmissions with efficiency characteristics similar to the synchro-mesh type cost an owner \$175 to \$200 extra.

Reasons for this wide price differential are apparent. For one, automatic transmissions weigh more than their hand-shifted competitors and cost is proportional to weight. The 217.5-lb Dynaflo transmission, for example, supplants a synchro-mesh transmission, flywheel, clutch, and related controls weighing 170 lb.

Another cost-boost feature of these newly-accepted transmissions using torque converters is the expensive plaster-mold process for fabricating the aluminum-bladed wheel units. Close tolerances must be held on these extremely complex blade forms. Making these units from sheet metal would reduce flow efficiency, it is currently believed, because of blade shape limitations.

And hydraulic controls, pumps, valves, accumulators, and pressure regulators are all cost-increasing components. Every design today for an efficient automatic transmission embodies enough of these features to make it cost four to six times more to produce than the conventional geared transmission.

Not only will the driver pay more for the automatic transmission when he first buys the car, but his gasoline bill will be higher throughout the car's life. Here's why. Hydraulic torque converter efficiency is about 85% with the pump running twice as fast as the turbine - at low speeds. Efficiency is 98% when the converter acts as a fluid coupling in normal forward driving.

Obviously this efficiency loss makes for greater gasoline consumption, especially in city driving.

Even on the highway the automatic transmission gives less miles-per-gallon than the geared type. Conservative estimates of this loss vary from $\frac{1}{2}$ to $1\frac{1}{2}$ mpg, depending on the type of driving.

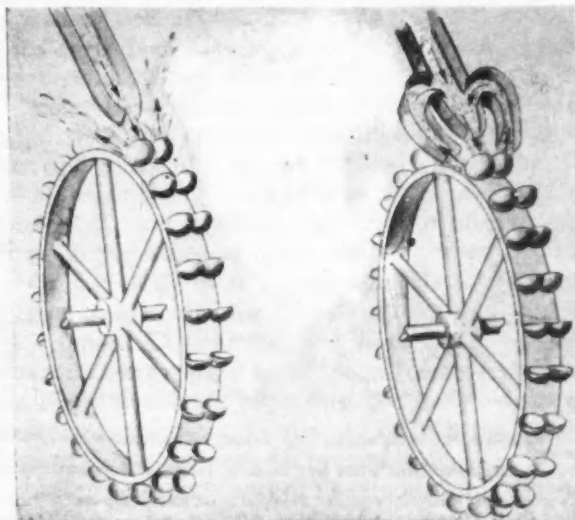
(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Hydraulic Analogy Explains Torque Converter Action

The torque converter behaves like a waterwheel with cup-shaped blades, in the left-hand sketch, which smoothly redirects water flow from the trough and discharges it backward. If the wheel is held stationary, speed of this backward flow equals that leaving the trough and striking the blades. The water exerts double pressure on the wheel while creating this reverse flow. In other words, the curved blading doubles the torque or turning effect produced by water striking flat paddle-like blades, that spill it off to each side.

Now suppose we use the unexpended energy in the water leaving the curved vanes by redirecting it into the trough, as in the right-hand sketch. It aids original flow by building up added force on the vanes. Magnitude of the added force decreases as the wheel starts to move because the backward flow slows down.

A hydraulic torque converter works in the same way to multiply torque or driving effort. The pump corresponds to the trough with its head of water, the turbine to the waterwheel with its curved blades, and the stator to the redirecting chutes.



THE SAE Construction and Industrial Machinery Technical Committee has just completed three projects, one of which will appear in the 1948 SAE Handbook, reported Committee Sponsor C. G. A. Rosen, Caterpillar Tractor Co., on Jan. 13, at the Annual Meeting.¹

The completed projects are:

1. Standardization of drawbars and rear-mounted units on tractors.

2. Recommended simplification of tire and rim sizes and types for construction and industrial machines.

3. Yardage rating of bodies and buckets.

Drawbar standards for track-type tractors already have received Technical Board approval. They're shown in Fig. 1. Aim of the CIMTC Subcommittee that developed this standard was to standardize only those features that affect the attaching of towed implements, leaving as much freedom of design as possible to the tractor manufacturer.

Tractors and equipment now in the field served as a guide in preparing this standard. Features such as overall jaw height, pin length, pin locking means, pin entering taper, heat-treatment and bar-locking methods were considered the design prerogative of each individual company.

Another job tackled by the same subcommittee, under J. W. Bridwell, Caterpillar Tractor Co., and now nearing completion is the standardization of mountings. This project concerns itself with units

Earthmoving

such as cable controls and winches which may be mounted safely using a relatively small spread of locating holes around a pilot hole in the rear of the transmission. The program includes mounting standards for light as well as heavy-duty equipment such as logging and oil-field winches.

First portion of the standards for small units will be the same for all tractors from 50 to 175 drawbar hp. The mountings for heavy-duty winches will be divided into the following groups since it's necessary to provide the greatest possible spread of bolt space for secure anchorage:

- Class II, Group I - 51 to 75 drawbar hp;
- Class II, Group II - 75 to 100 drawbar hp;
- Class II, Group III - 100 to 125 drawbar hp;
- Class III - 125 to 175 drawbar hp.

Big step was made in reducing the number of haulage and grader tire sizes in the recommended tire classification recently submitted by the Committee to the Technical Board. The 35 haulage type tires recommended, Table 1, were selected from 41 different types. Out of 26 types of grader tires, the Committee recommended 19 in its proposal, as shown in Table 2. Table 3 shows comparable tire types by brand name.

Table 1 - Proposed SAE Off-Highway Tire Classification

Section Diameter	Haulage Type*							Recommended Practice				
	Current Practice Rim Diameter							Rim Diameter				
8.25	20	24	25	29	32	33	40	20	24	25	29	33
9.00	10	12	12	12	12	12	12	10	12	12	12	12
10.00	12	12	12	12	12	12	12	12	12	12	12	12
11.00	12	12	12	12	12	12	12	12	12	12	12	12
12.00	14	16	16	16	16	16	16	14	16	16	16	16
13.00	14	18	18	18	18	18	18	14	18	18	18	18
14.00	16	16	16	16	16	16	16	12	16	16	16	16
15.00	16	20	20	20	20	20	20	16	20	20	20	20
16.00	16	20	20	20	20	20	20	16	20	20	20	20
17.00	16	20	20	20	20	20	20	16	20	20	20	20
18.00	16	20	20	20	20	20	20	16	20	20	20	20
19.00	16	20	20	20	20	20	20	16	20	20	20	20
20.00	16	20	20	20	20	20	20	16	20	20	20	20
21.00	16	20	20	20	20	20	20	16	20	20	20	20
22.00	16	20	20	20	20	20	20	16	20	20	20	20
23.00	16	20	20	20	20	20	20	16	20	20	20	20
24.00	16	20	20	20	20	20	20	16	20	20	20	20
25.00	16	20	20	20	20	20	20	16	20	20	20	20
26.00	16	20	20	20	20	20	20	16	20	20	20	20
27.00	16	20	20	20	20	20	20	16	20	20	20	20
28.00	16	20	20	20	20	20	20	16	20	20	20	20
29.00	16	20	20	20	20	20	20	16	20	20	20	20
30.00	16	20	20	20	20	20	20	16	20	20	20	20

Note 1. All figures included in body of chart indicate the ply rating of the particular tire size shown.

Note 2. The tire manufacturer's data book should be consulted for availability of the desired type of tire.

* This proposal has been sent to the SAE Technical Board for final approval.

¹Paper "Report on Activities of SAE Construction and Machinery Technical Committee"

Table 2 - Proposed SAE Off-Highway Tire Classification

Grader Tire*					
Section Diameter	Current Practice		Recommended Practice		
	Rim Diameter		Rim Diameter		
6.00	20	24	20	24	Flat Band
	6	8	6	8	
6.50	8	8	8	8	
7.00	8	8	8	8	
7.50	10	10	10	10	
8.25	10	10	10	10	5 deg Band
9.00	10	10	10	10	
	10	8	10	8	
10.00	10	8	10	8	
	10	8	10	8	
11.00	10	8	10	8	
12.00	10	6	10	6	
	10	8	10	8	
	10	8	10	8	
	10	8	10	8	
13.00	8	12	8	12	
14.00	12	8	12	8	
	14	14	14	14	
16.00	12	14	12	14	

Note 1. All figures included in body of chart indicate the ply rating of the particular tire size shown.

Note 2. The tire manufacturer's data book should be consulted for availability of the desired type of tire.

* This proposal has been sent to the SAE Technical Board for final approval.

Machinery Standards

Other work now occupying this subcommittee, headed by H. L. Rittenhouse, Euclid Road Machinery Co., concerns wide-base rims and valve stems. This group has made considerable progress in compromising differences presently responsible for noninterchangeability of wide-base rims. The conferees are optimistic about early agreement on standards along this line.

Valve stems and extensions present a tougher standardization problem. And interchangeability of adapters and chucks for jumbo valves is not an easy-to-achieve goal. Despite the difficulties ahead in this area, the Committee looks to eventual agreement on much-needed standards of this type.

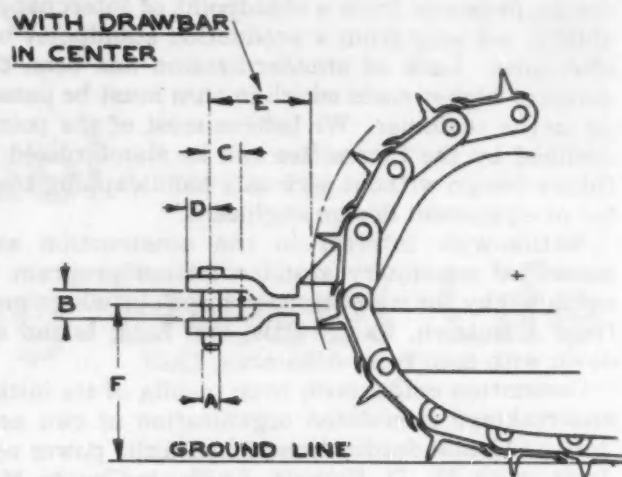
Yardage Ratings

Of much interest to builders and users of construction machinery, particularly of the earth-moving variety, are the standards proposed for yardage rating of bodies and buckets. These struck and heaped capacity ratings for carry-type scrapers and truck and wagon bodies, shown in the tabulation on page 42 are now up for letter ballot to the main committee.

In formulating these proposed standards, the subcommittee members considered possible interference with other industry rating standards. But these are on a weight basis, which is not suitable for the construction industry. The proposed SAE ratings, based on volume, offer no interference with these existing standards. The SAE-proposed standards are tailored to the construction industry be-

Table 3 - Comparable Off-Highway Tire Types by Trade Name

Designation Group	Firestone	General	Goodrich	Goodyear	U. S.
Haulage Tires					
1 MT	Ground Grip	Tu-Way Earth Mover	Super Traction Universal	Sure Grip	Con-Trak-Tor Lug Traction
2 RK	Rock Grip Excavator	L. C. M.	Rock Service All Purpose	Hard Rock Lug	
3 GP	All Traction Logger			Road Lug	Fleet Delivery Off-Road Earth Mover
4 EM	A. N. S. Earth Mover	Earth Mover	Earth Mover	All Weather Earth Mover	
Road Grader Tires					
5 TG	Group Grip Road Builder	Tractor Grader	Tractor Grader Lug Type	Sure Grip Grader	Road Grader
6 RG	Rib Road Builder	Rib Grader	Tractor Grader Ribbed		Road Grader (Rib)



	CLASS I 0-50 D.B.H.P.	CLASS II 51-125 D.B.H.P.	CLASS III 126-175 D.B.H.P.
A	1 1/2 DIA.	1 3/4 DIA.	2 DIA.
B	2 1/2	3 1/2	3 3/4
C	2 1/4 MIN.	3 1/4 MIN.	4 MIN.
D	2 R. MAX.	3 R. MAX.	3 1/2 R. MAX.
E	4 MIN.	6 MIN.	8 MIN.
F	12 TO 15	14 TO 18	16 TO 21

Fig. 1 - Track-type drawbar standards

cause it's almost universal practice to compute amount of earth moved on a yardage basis.

An interesting discussion emerged as to whether to figure heaped capacities of truck and wagon bodies on a slope of 1 vertical to 2 horizontal or 1 vertical to 1 horizontal. Trucks and wagons on long hauls traveling at high speeds may have to be loaded with flatter slopes to prevent excessive spillage. But many of these vehicles worked on short hauls at low speeds are loaded as high as the material will stand. The proposed standard takes into consideration any such differences in practice required by the nature of the material or the haul.

After the industry gains some experience in the field with the proposed yardage ratings for scrapers and truck and wagon bodies, the subcommittee, chairmanned by T. Davidson, Bucyrus-Erie Co., will tackle capacity ratings for tractor shovel dippers, drag scrapers, and other construction equipment.

Only a little over a year ago the SAE Technical Board launched the Construction and Industrial Equipment Committee, the first group of its kind devoted exclusively to cooperative technical action on basic problems besetting the heavy-duty earth-moving equipment industry. Its chairman is D. B. Baker, International Harvester Corp.

After being advised of the group's objectives and program, one of the industry's leading executives said, "There is no question but that all allied equipment manufacturers have been confronted with

design problems from a standpoint of interchangeability, not only from a production standpoint but also sales. Lack of standardization has been the cause of higher costs which in turn must be passed on to the customer. We believe most of the points outlined by the Committee can be standardized in future design without seriously handicapping tractor or equipment design engineers."

Nation-wide interest in the construction and industrial machinery standardization program is exhibited by the well-attended meetings where men from Allentown, Pa., Seattle, and Long Island sit down with men from Alhambra, Calif.

Committee enthusiasm over results of its initial undertakings stimulated organization of two new jobs: (1) standardization of hydraulic power controls, with W. D. Barrett, LaPlante-Choate Mfg. Co., as sponsor and (2) electrical equipment standardization, under the sponsorship of T. A. Hopkins, Caterpillar Tractor Co.

Proposed SAE Standard for Yardage Rating of Carry Type Scrapers*

1. Rated capacities shall be on the basis of cubic yards.
2. Standard ratings shall include both STRUCK and HEAPED CAPACITIES.
3. The STRUCK CAPACITY of a scraper shall be determined by the product of the area of the side plates contacted by the load multiplied by the width between side plates. (Most scrapers have straight, parallel side plates and flat bottoms, and allowance shall be made for appreciable departure from such construction.) The struck capacity shall be given to the nearest one tenth (0.1) cu yd.
 - 3.1 When the top of the front apron, in the closed position, is below the top edge of the side plates the capacity shall be limited either by planes following the contour of the side plates or by the plane at a slope of one vertical to one horizontal, whichever gives the smaller capacity.
 - 3.2 To determine the one to one slope for the limiting plane, the cutting edge shall be set to contact the horizontal plane between the front and rear ground supports; for pneumatic tired vehicles standard size tires at rated, full load deflection shall be used. For a two-wheel scraper whose position is established by the tractor, the height of the hitch shall be taken as the average of the range of standard drawbar heights for the size tractor with which the scraper normally will be used.
 - 3.3 Mechanisms which are not a part of the side plates but which are adjacent to them and will retain additional load shall be included in the determination of STRUCK CAPACITY. An extension of the ejector or a rear

plate above the side plates shall not be included in the determination of STRUCK CAPACITY.

4. HEAPED CAPACITY shall be the volume enclosed by the bowl and apron and four planes at a slope of one vertical to one horizontal, extending upward and inward from the top of the front apron, from the top of the ejector or rear plate and from the top edges of the side plates. For scrapers of less than twelve (12) cu yds STRUCK CAPACITY, the HEAPED CAPACITY shall be given to the nearest one half ($\frac{1}{2}$) cu yd; for scrapers of twelve (12) cu yds STRUCK CAPACITY and larger the HEAPED CAPACITY shall be given to the nearest whole cu yd.
 - 4.1 To determine the one to one slope for the limiting planes, the cutting edge shall be set to contact the horizontal plane between the front and rear ground supports; for pneumatic tired vehicles standard size tires at rated, full load deflection shall be used. For a two-wheel scraper whose position is established by the tractor, the height of the hitch shall be taken as the average of the range of standard drawbar heights for the size tractor with which the scraper normally will be used.
 - 4.2 If the top edge of the side plate (or extension thereof, paragraph 3.3) is not a straight line, a mean line through its configuration may be used to establish the side planes of the HEAPED CAPACITY.
 - 4.3 The possible interference of overhead structures such as sheave guides, cables, etc., with the HEAPED CAPACITY shall be ignored.
 5. Both the STRUCK and HEAPED CAPACITIES as set forth herein are, with minor reservations, definitely measurable quantities which delimit the probable loading characteristics of the vehicle.
 6. It is not the intention of this Standard to attempt any conversion of these figures to capacity in terms of pay yards, nor to propose any formula for so doing. All such conversions or estimates, it is felt, fall within the province of the contractor and the engineer for each specific project.
- * This proposal is up before the SAE CIMTC Committee on letter ballot and, if approved, will be submitted to the Technical Board for final approval.

Proposed SAE Standard for Yardage Rating Of Truck and Wagon Bodies *

1. Rated capacities shall be on the basis of cubic yards.
2. Standard ratings shall include both STRUCK AND HEAPED CAPACITIES.

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SULFUR in Fuel Seen Shortening Diesel Life

BASED ON A PAPER* BY

L. A. BLANC

Assistant Director of Research
Caterpillar Tractor Co.

(This paper will be published in full in SAE Quarterly Transactions)

SULFUR content is the most important characteristic of a diesel fuel, as far as engine life is concerned, assuming the fuel has a cetane number sufficiently high to provide satisfactory ignition and the purely mechanical problems of cleanliness and flow rate are satisfactorily handled.

This is the net result of tests with a 5 $\frac{3}{4}$ x 8-in. precombustion-chamber diesel test engine, using the L-1-545 procedure with modifications involving the outlet temperature of the cooling water, the composition of the fuel, and the composition of the lubricating oil used. Test conditions are given in Table 1.

The fuels used varied in sulfur content from 0.12 to 1.43%, in cetane number from 41 to 61, in nitrogen content from 0.00 to 0.08, and in viscosity at 100 F from 36 to 64 SSU. Corrosion after 3 hr at 210 F was negligible for all fuels.

Effect of Variables

The effect of several variables was found to be as follows:

1. Sulfur content: At a coolant temperature of 175 F, cylinder wear was low or moderately low in all cases, whereas top ring wear increased uniformly with increasing sulfur content of the fuel. When sulfur content was less than 0.5%, the pistons were relatively clean, even though hydrocarbon composition and distillation range varied

widely. There were only small differences in the quantities of deposits formed on the pistons. The lubricating oil and additive were still in relatively good condition when the oil was drained after 120 hr of operation. When the sulfur was increased above 0.5%, the pistons became progressively dirtier, the ring grooves packed with carbon, and the rings became more sluggish. With sulfur content greater than 1.0%, stuck rings became common. There was also a progressive loss of additive and deterioration of the lubricating oil with increasing sulfur content.

When a coolant outlet temperature of 100 F was used, there was the same progressive increase in piston deposits, although the quantities involved were much less. There was also a progressive deterioration of the lubricating oil with increasing sulfur content. The loss of additive was not as pronounced, although it is probably obscured by iron in the filtrate ash.

Tests at 175 F coolant outlet temperature indicate that no heavy-duty oil performs as well on high sulfur fuel as it does on low sulfur fuel, although all perform better than straight mineral oil in some respects; also, high sulfur fuel causes a much wider spread in the results with heavy-duty oils than the low sulfur fuels do. There is a large increase in ring wear, and an increase in cylinder

Table 1 - Test Conditions

Bmeep, psi	75
Engine Speed, rpm	1000
Input, Btu per min	2950
Oil Temperature to Bearings, F	145-150
Oil Pressure to Bearings, psi	30
Length of Test, hr	430
Oil Drain Period, hr	120

*"Effect of Diesel Fuel Characteristics on Engine Deposits and Wear" was presented at the SAE National Fuels & Lubricants Meeting, Tulsa, Nov. 6, 1947

wear, although this increase is small in some cases. The increase in piston deposits is definite with all heavy-duty oils, although in some cases it is more extreme than in others. In all cases, the heavy-duty oils showed a marked loss of additive. The straight mineral oil is poorest in all respects, although the wear results obtained with some heavy-duty oils are no better.

2. Nitrogen compounds: Tests showed that within the nitrogen content range of the fuels used, nitrogen had no undesirable effects on deposits or wear.

3. Temperature: Lower jacket temperatures produce less deposits but greater wear in a degree that varies with the sulfur content, and the results obtained with a given engine will depend on the temperatures involved, the amount of sulfur consumed, the lubricating oil used, and oil drain practice.

4. Oil change period: There was a remarkable decrease in ring sticking, deposits, and wear resulting from a change in oil drain period from 240 hr down to 60 hr.

5. Cylinder material: It was possible by a choice of material to reduce wear almost to normal under the lower temperature conditions with the particular fuel-lubricating oil combination used in the tests. Ring wear, however, remained high.

Although the above conclusions are based on tests with a precombustion engine, tests with two other types of high-speed diesels indicated that similar results would have been obtained with them. Results differed only as indicated by the effect of temperature, load, oil change period, and the amount of ring side clearance to be taken up before ring sticking occurred.

Cylinder-Wear Measurement

One of the difficulties in the way of explaining or correlating cylinder wear rates with other factors is due to the inadequacy of present methods of cylinder wear measurement, and from our lack of understanding of the purely mechanical details of the ring and cylinder wear mechanism. It is clear that the increase in cylinder diameter in two directions at the top of top ring travel gives only a qualitative indication of the amount of material worn off the cylinder. The method of correlation with iron in the lubricating oil suggested by Moore is useful under certain conditions, but it does not separate ring and cylinder wear, nor does it give any indication of the diametral increase of the cylinder.

(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

EARTHMOVING MACHINERY STANDARDS

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3. The STRUCK CAPACITY of a truck or wagon body shall be the actual volume enclosed by the body, struck off by a straight line passed along the top edge of the side plates. The STRUCK CAPACITY shall be given to the nearest one tenth (0.1) cu yd.

3.1 For bodies with one end open, the capacity at such end shall be limited by a plane passing through the edge of the bottom plate at a slope of one vertical to one horizontal.

3.2 Extension of end plates above the sides shall not be included in the STRUCK CAPACITY.

4. HEAPED CAPACITY shall be the volume enclosed by the body, and by four planes at a slope of one vertical to one horizontal, extending upward and inward from the top edges of the side and end plates. For bodies of less than twelve (12) cu yds STRUCK CAPACITY, the HEAPED CAPACITY shall be given to the nearest one half ($\frac{1}{2}$) cu yd; for bodies of twelve (12) cu yds STRUCK CAPACITY and larger, the HEAPED CAPACITY shall be given to the nearest whole cu yd.

4.1 For bodies with one end open, the HEAPED CAPACITY at such end shall be limited by a continuation of the plane limiting the STRUCK CAPACITY.

4.2 If the top edge of a side or end plate is not a straight line, a mean line through its configuration may be used to establish the sloping top plane of the HEAPED CAPACITY.

5. Both the STRUCK and HEAPED CAPACITIES as set forth herein are, with minor reservations, definitely measurable quantities which delimit the probable loading characteristics of the vehicle.

6. It is not the intention of this Standard to attempt any conversion of these figures to capacity in terms of pay yards, nor to propose any formula for so doing. All such conversions or estimates, it is felt, fall within the province of the contractor and the engineer for each specific project.

* This proposal is up before the SAE CIMTC Committee and, if approved, will be submitted to the Technical Board for final approval.

Proposes TRAFFIC CONTROL SYSTEM for High-Speed Aircraft

BASED ON A PAPER* BY

MILTON W. ARNOLD

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AIR TRANSPORT ASSOCIATION OF AMERICA

AIR traffic control needs drastic modification to keep pace with the higher speeds of new aircraft.

Large, high-speed aircraft must have guidance for take-off similar to that now given for landing. And some guidance must be supplied all along the en route phase of the flight until landing controls again take over.

The whole system must be automatic, error-free, self-checking. And communication between ground control agency and aircraft must be automatic, with voice-reporting serving only to supplement information presented by lights, meters, and pictorial maps.

Basically, the traffic control system for high-speed aircraft must satisfy these four general requirements:

1. Each pilot must be provided means for indicating to the traffic control agency the flight plan he wishes to follow. This is already being met by flight plans filed by the pilot before take-off and en route amendments.
2. The pilot of each aircraft must know his position at all times.
3. The traffic control agency must know continuously the location—and if possible, the identity—of all aircraft over which it is exercising control. It must also know the approximate times of arrival of aircraft approaching its control area.
4. The traffic control agency must be provided means for indicating continuously to each aircraft the position where it should be on its route.

The operations man is concerned mainly with what services the traffic control equipment should render. The design of the needed navigation, position-reporting, and block-signal equipment is left to electronics engineers—or anyone else who wants to try it.

*Paper "Proposed Air Traffic Control and Controlled Handling Systems for High-Speed Aircraft," was presented at SAE National Air Transport Engineering Meeting, Kansas City, Mo., Dec. 2, 1947.

Speaking from the operations viewpoint, here is a proposed system which would overcome the bottlenecks that would result if planes of 600-mph speed were used with the present system:

The pilot files his flight plan and receives clearance for the flight before take-off, as he does now.

Then the proposed system provides take-off control similar to that now available for landing. The take-off system gives left-right, up-down, and distance information along the take-off path to the pilot. Besides this, it controls the aircraft directly through an autopilot, the autopilot being monitored by the pilot. A separate and independent monitor on the ground checks the operation of the navigation aid. (The monitor could be CGA or a similar radar device.)

By providing automatic, language-free instructions for take-off and self-checking acknowledgments, the proposed system speeds up instructions, relieves overloaded voice channels, and reduces chance for error.

Certain minimum intervals must be maintained between aircraft on take-off, and between aircraft on take-off and those coming in to land on the same runway. In the new system, this minimum clearance is maintained automatically (perhaps from data extracted automatically from radar equipment). The pilot is given continuous pertinent data in map form, so that he sees what the ground controller sees, and can anticipate instructions.

When the plane is airborne, it climbs to its cruising altitude along a prescribed route, and the guidance continues. The pilot receives data on the distance and course to destination so that he can maintain proper heading and estimate his time of arrival accurately. The navigation data are fed to the autopilot and also presented to the pilot for his use in monitoring the autopilot, or in case the autopilot fails, for use in manual flight direction.

Because the proposed system relays distance

information as well as left-right information to the pilot, he knows his exact position at all times. The position is reported to the ground control agency automatically (probably at a certain time instant or on request from the ground). The position report also identifies the aircraft, allowing the ground agency to correlate position with flight plan.

The ground agency determines ground speed from successive position reports, and knows the plane's route from the flight plan. From these two pieces of information, it can estimate time of arrival. If this estimated time of arrival is not what the ground agency wants it to be, the agency transmits course changes or speed differentials to the plane.

This "flow control" gives the pilot a time tolerance on his progress along the route. It may be presented to him on lights, meters, indicator signals, or pictorial indicators. The acknowledgment indicates not only that transmission has been received, but also what the transmission was. Succeeding position reports enable the ground agency to determine how well the flow instructions have been carried out.

The initial approach to the terminal zone is much the same as en route operation, as far as the proposed system is concerned. The control becomes tighter, position report is given more often, and so are flow instructions. In the terminal area, the pilot is again given a continuous, up-to-date traffic map (by means of television or radar relay probably).

In a high-traffic-density area such as New York, the system would be set up to lead high-speed aircraft through the approach pattern to arrive at the beginning of the landing path at precisely the time desired by traffic control. This means automatic flight controlled by navigation data. The approach will be monitored both by the pilot and by the ground agency.

Other, slower-speed aircraft may not carry the necessary equipment to regulate approach so precisely. They would be handled by the same overall system, which would instruct them to overshoot if the airport could not handle the landing, and later bring them back for another approach.

Complete automatic touch-down might be a part of the proposed system. Last-minute maneuvers of large, high-speed aircraft can be only very limited at landing. Therefore, completely automatic touch-down would be especially valuable in eliminating the possibility of a false maneuver under manual control.

High-intensity approach and runway lights must be a part of the traffic control system. They enable the pilot to set the aircraft down by visual observation or at least to monitor the autopilot's landing. (A block system warns of runway occupancy (either by cockpit lights or by runway traffic lights).

All surface movements on the airport are also handled by the air traffic control agency, in the proposed system. The tower knows the position of all objects - fixed and moving - on the airport. The tower gives instructions by automatic communication where possible, with voice used for additional or overriding instructions only.

Equipment Needs

For the proposed system, the instrument designers are going to have to devise a highly accurate means of navigation, one much more accurate than today's systems. The current four-course radio range sets up airways which must be 10 miles wide. Only very close to the station does the radio range permit two-directional traffic on the same level within the 10-mile width. Traffic in opposite directions must be handled by altitude separation or by two airways totaling 20 miles. With this arrangement, several routes leading out from the airport must remain common until there is sufficient lateral space to establish separate airways. One slow aircraft on the common airway can hold up a number of faster planes on several routes. And the speed differential will increase as higher-speed planes come into use, because there will still be some slow-speed traffic.

The navigation aid for the proposed air traffic control system will have to be capable of furnishing separate lateral routes for each speed category of aircraft. Altitude separation will not suffice because the climbing and descending paths of different speed aircraft would conflict.

Besides the navigation aid, instrument designers will be asked to produce an automatic position-reporting device. This may be a big problem, but it is absolutely essential that it be solved.

Flow control depends on adequate position reporting, and high-speed aircraft must have flow control to eliminate holding. The impossibility of holding high-speed aircraft becomes apparent when one considers the tremendous fuel consumption and the wide holding circle needed. Assuming a bank angle of 20 deg, the holding circle for an aircraft traveling 600 mph would be around 18 miles in diameter. This means that each parallel airway would have to be even wider than 18 miles. Of course, the airplane could be slowed down to reduce the holding circle, but the efficiency of the engine operation would also drop.

With flow control alone, an error in human judgment at the control agency might allow unsafe conditions to develop. Overlaying the flow control system, there must be a block signal system similar to that used by the railroads.

A block signal system suitable for aircraft use is another problem for the instrument engineers.

(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

EXCERPTS FROM A PAPER* BY

Edward R. Grace

Vice President
Grant Advertising, Inc.

According to National Survey:

Public Wants Smaller, Cheaper Car

■ **Who Was Interviewed:** The light-car survey was conducted during December, 1947, in 16 American cities with graduated populations. (They're listed in the tables in this article.) A total of 1619 car drivers was interviewed and more than 2000 calls were made to get this many respondents who drive cars. Calls were made in all income groups — \$5000 or over annually, \$3000 to \$5000, \$1500 to \$3000, and below \$1500.

Age group breakdown used was based on census figures of the U. S. Bureau of Census. It was as follows: under 30 years of age, 31%; 30 to 40, 27%; 40 to 50, 23%; and over 50, 19%. About 75% of the calls were made to men, 25% to women.

MANY weeks of study in interviews with men and women of various ages in various income brackets across the country show that more than half the people want a light, small car that's cheaper. A number of engineers in the industry say such a car can be produced; financial men feel it should be produced.

More than half the people interviewed, a national percentage of 60.4, said they believed the leading motor car manufacturers should produce a smaller, lighter car in addition to their present models. There does not seem to be any great difference in opinions of the men or women interviewed about production of this car. Neither is there any noticeable difference in the younger or older age groups. This would seem to show that this type of automobile would be equally acceptable to a man or woman and to those "under 30" or over.

Almost three-fourths of the people interviewed, or an average of 72.7%, who said the manufacturers should produce this smaller, lighter car said they would buy one in preference to the present lowest priced cars. Again, sex or age group seems to make no difference.

Of the people who said they would buy one of these smaller cars in preference to the present lowest priced cars, 67% would buy it as a first (or only) car while 32% would buy it in addition to another car.

Top reason given for buying this smaller car seems to be "lower price" with "lower maintenance"

second and "greater driving convenience" third.

Summary of replies to most of the questions asked the public is tabulated in this article.

Engineers Have Their Say

We also conducted a survey of passenger car engineers, a number of whom replied that they believe a smaller, lighter car could be produced with adequate factors of safety, greater fuel economy, and at a lower purchase price. The suggested specifications set up by the replies range from a 95 to 115-in. wheelbase, a 50 to 60-in. tread, and horsepower ranging from 30 to 80. Curb weight ranged from 2000 to 2800 lb, with a lower retail price ranging from 8 to 35% less than present low-price makes.

Few of the respondents were specific as to lower maintenance costs or great mileage. However, opinions ranged from 10 to 25% lower maintenance as a possibility. They also felt that the cars should last five years and be good for from 50,000 to 100,000 miles.

One of the engineers said that the use of new materials for other than embellishment could not be employed, except in a few major units where steel and grey iron would give way to aluminum or magnesium. Saving in engine weight covered a wide range of opinion, and would vary according to design, materials, and horsepower. But engine weight alone, several felt, could be reduced from 30 to 50%.

All believed that the car should have a front and rear seat, but did not agree as to the number of

*Paper "Do Americans Want a Small, Light Car?" was presented at SAE Annual Meeting, Detroit, Jan. 12, 1948.

CITY	QUESTION 1 Should manufacturers produce a smaller, lighter car?		QUESTION 2 Would you buy one?		QUESTION 4 Buy it because of:			QUESTION 5 Price believed Car should sell for:			
	Yes	No	Yes	No	Lower Price	Lower Main- tenance	Greater Driving Convenience	Under \$750	\$751- \$1000	Over \$1000	Don't Know
	Yes	No	Yes	No	Yes	No	Yes	Yes	No	Yes	No
National Average	60.4%	39.6%	72.7%	27.3%	74.5%	61.7%	43.7%	17.5%	61.2%	16.5%	4.8%
New York	61.5	38.5	70.3	29.7	72.2	57.8	50.0	24.4	47.8	24.4	3.3
Chicago	54.5	45.5	65.9	34.1	65.7	41.1	32.1	12.6	75.8	8.9	1.8
Los Angeles	64.6	35.4	82.9	17.1	67.2	58.9	58.4	12.0	61.5	7.7	17.9
Detroit	83.8	16.2	73.6	26.4	74.7	65.3	51.6	7.4	67.4	20.0	8.3
Boston	13.1	86.9	75.0	25.0	66.7	66.7	50.0	16.7	83.3	0.0	0.0
Minneapolis	64.2	35.8	75.9	24.1	62.5	47.5	32.5	7.5	87.5	5.0	0.0
Kansas City, Mo.	74.4	25.6	79.3	20.7	67.0	71.7	52.3	41.3	52.2	4.3	2.2
New Orleans	75.9	24.1	68.3	31.7	62.9	78.0	36.6	7.3	65.9	22.0	4.9
Seattle	51.8	48.2	81.4	18.6	60.0	60.0	42.9	11.4	54.3	22.8	11.4
Atlanta	87.7	12.3	72.3	27.7	60.9	83.0	50.0	17.0	65.9	14.9	2.1
Dallas	55.7	44.3	77.6	22.4	61.6	75.9	63.1	15.8	52.6	28.9	2.0
Omaha	59.5	40.5	92.0	8.0	75.3	66.6	45.7	19.5	54.3	19.6	6.5
Miami	43.7	56.3	61.3	38.7	57.9	47.4	31.6	21.0	65.8	10.6	2.0
Des Moines	46.7	53.3	88.1	11.9	46.6	54.1	35.1	37.8	51.4	5.4	5.4
Topoka	76.8	23.2	71.4	28.6	73.3	60.0	13.3	17.0	64.4	13.3	4.4
Weslaco	50.0	50.0	54.5	45.5	58.3	33.3	25.0	8.3	16.7	66.7	8.3

passengers to be accommodated by each. Perhaps it was unfair to ask the respondents to be specific in setting forth their ideas for a smaller, lighter car. One leading manufacturer came out flat-footedly and said it would be a mistake for the leading producers to build one. But the rest were very amenable to the idea and in the case of five prominent engineers, complete specifications were tabulated.

In this connection, a leading tire manufacturer was most constructive with what could be possible in the way of a smaller, lighter car - but added the remark that "the average American car buyer is not going to be very much more interested in a smaller, lighter car than he now is in any one of the "big three." "Economics, not desire," he stated, "will be the lever which pries in the direction of a smaller car."

New Materials Costly

One engineer made a strong point in reference to substituting aluminum or magnesium for iron and steel in an effort to reduce costs. He pointed out that the differential in price of 24¢ per lb for the former and 6¢ per lb for the latter indicates

that such a substitution would represent an increase in cost of approximately \$300, to say nothing of additional costs in labor due to processes of fabricating the lighter materials. Therefore, the final result in reducing weight 1000 lb would show an increased cost of from 35% to 50% more than the heavier car made of iron and steel, using present low-priced car weights for comparative purposes.

Weight and Price Going Up

He also stated that his company's present-day model weighs only about 200 lb more than the 1937 model, with approximately the same component parts and relatively no change in the size of the body, except for fractions of inches here and there. Yet their 1937 model that sold for between \$600 and \$700 lists at twice that price today. And the percentage of profit on the higher-priced present-day model is less than it was on the 1937 car.

He points out that while there might be a reduction in weight for a car of equal size through the use of lighter materials, experience shows it would require some six to eight years of lower operating

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CITY	QUESTION 6 Top Speed for Car					QUESTION 8 No. of Cylinders for Car				QUESTION 10 Miles Per Gallon				
	Over 85 Mph	65-80 Mph	45-60 Mph	Under 45 Mph	Don't Know	4 Cyl	6 Cyl	8 Cyl	Don't Know	Under 20	20-25	25-30	Over 30	Don't Know
	Yes	No	Yes	No	Yes	Yes	No	Yes	No	Yes	No	Yes	No	Yes
National Average	8.8%	48.4%	37.7%	0.4%	4.6%	27.7%	59.2%	6.3%	6.8%	12.2%	39.2%	34.2%	8.6%	5.8%
New York	31.0	45.6	17.8	1.1	4.4	26.7	66.7	2.2	4.4	12.2	37.8	35.6	13.3	1.1
Chicago	14.3	44.6	39.3	...	1.8	21.4	71.4	3.6	3.6	17.9	60.9	12.5	7.1	1.8
Los Angeles	10.3	38.5	25.6	...	25.6	20.5	33.3	20.5	25.6	5.1	56.5	17.9	...	20.5
Detroit	3.2	51.6	41.1	...	4.2	15.8	74.7	3.2	6.3	9.5	38.9	29.5	9.5	12.6
Boston	...	...	100.0	...	...	83.3	16.7	...	...	...	...	83.3	16.7	...
Minneapolis	...	42.5	55.0	2.5	...	27.5	65.0	2.5	5.0	...	32.5	52.5	10.0	5.0
Kansas City, Mo.	4.4	70.3	17.3	...	...	15.2	47.8	17.4	19.6	65.3	17.4	13.0	4.3	...
New Orleans	4.8	53.8	39.0	...	2.4	19.5	63.5	14.6	2.4	9.8	39.0	46.3	...	4.9
Seattle	2.9	31.4	48.6	17.1	...	37.1	48.5	5.7	8.6	8.6	25.7	42.9	14.3	8.6
Atlanta	6.4	55.3	38.3	...	...	17.0	70.2	10.6	2.1	2.1	55.3	38.3	...	4.3
Dallas	7.9	42.1	50.0	...	...	28.9	68.4	2.6	...	7.9	31.6	47.4	13.1	...
Omaha	8.7	39.1	50.0	2.2	...	39.1	52.2	...	8.7	19.6	43.5	28.3	4.3	4.3
Miami	2.6	47.4	50.0	...	...	52.6	39.5	5.3	2.6	10.5	34.2	39.5	15.8	...
Des Moines	2.7	48.6	48.6	...	...	50.5	35.1	5.4	...	2.7	60.5	24.3	10.6	2.7
Topoka	6.7	53.3	28.7	...	13.3	25.7	60.0	2.2	11.1	24.4	24.4	55.6	4.4	15.6
Weslaco	...	66.7	25.0	...	8.3	25.0	58.3	16.7	...	...	25.0	41.7	33.3	...

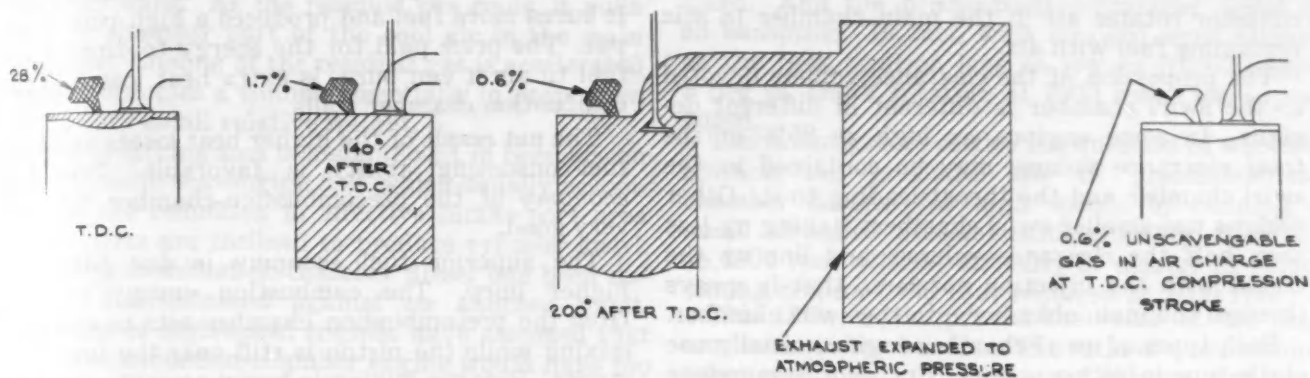


Fig. 1 - Effect of precombustion chamber on scavenging of 2-stroke diesel cylinder

Mixing Fuels and Air in Diesels

BASED ON A PAPER* BY

Lloyd E. Johnson

Staff engineer, Caterpillar Tractor Co.

STYLES in diesel combustion chambers are as varied as styles in women's hats - for a good reason. The variations result from different schemes for providing the energy to mix fuel and air rapidly.

Part of the mixing energy, at least, is furnished by the fuel injection pump. Usually rotation of the air charge is induced also, to aid mixing. Sometimes the air ports impart swirl to the air. Or air swirl may be induced by the piston in pushing air through a small passage from the main chamber to an auxiliary chamber. Other designs start combustion in the auxiliary chamber and use the energy of the burned gases rushing out of the auxiliary chamber to set up swirl.

Each method has some penalties, either high first cost, high maintenance cost, pumping losses, or high heat losses through the combustion chamber walls.

The fuel-injection pump always furnishes some of the mixing energy. In cases where it furnishes the major portion, fuel is sent to the clearance-volume air in several jets. The shape of the spray is very important, and the engine needs the most precise type of injection equipment.

Because the spray must penetrate even at slow

engine rpm's, orifices must be small and pressures high. At high speeds, the pressures are terrific unless the injection period is allowed to drag out. One manufacturer claims certain models of his injection equipment are built to withstand 30,000-psi pressure. The combination of small tolerances and high strength needed in such injection equipment makes it costly.

Many fuels do not burn cleanly at full load; even the best fuels can leave carbon deposits when the engine runs cold, as at idle. The deposits clog the tiny orifices, reducing the engine's operating efficiency. Frequent checking and cleaning of the orifices prevents the deterioration in efficiency.

In some engines, the inlet valve port or liner port initiates rotation of the intake air by directing it into the cylinder tangentially. Or rotation is accomplished by a mask on the inlet valve.

Speeding up the air and directing it tangentially produces the swirl pattern needed for good mixing, but it also results in a reduction of effective inlet port area. This means that volumetric efficiency is cut. In 2-stroke engines, tangentially directed intake ports in the cylinder wall are reduced in effective area in proportion to the cosine of the angle at which they are inclined from the direction normal to the bore.

In swirl-chamber engines, swirl induced by the piston in pushing air through the throat between the main chamber and an auxiliary swirl chamber brings air to the fuel spray and provides turbulence for mixing. Combustion may begin in the swirl chamber or in the main chamber, depending upon operating conditions. Either way, the last of the fuel in the auxiliary chamber is burned before combustion ceases in the main chamber. The rush

*Paper "Directing Fuel to Air for Combustion in an Engine," was presented at a meeting of the SAE Mid-Continent Section, Stillwater, Okla., Oct. 3, 1947.

of gases from the auxiliary chamber to the main chamber rotates air in the main chamber to mix remaining fuel with air.

The proportion of the clearance volume devoted to the swirl chamber is different in different designs. In some engines, as high as 85% of the total clearance volume may be contained in the swirl chamber and the throat leading to it. Other designs use smaller swirl chambers, taking up less than half the clearance volume, and line up the throat with the injection nozzle so that it sprays through the main chamber into the swirl chamber.

Both types of swirl-chamber engines usually use pintle-type injection nozzles. Such nozzles produce a relatively wide short spray. In some cases, a penetrating pilot core precedes the wide spray.

It takes a good spray pattern to direct the fuel to areas where the air can mix with it. A defective spray pattern noticeably increases smoke density and lowers maximum power and fuel economy.

Microscopic changes in dimensions of pintle-nozzle parts resulting from manufacturing tolerances or minor carbon deposits affect spray pattern markedly. But the manufacturers do manage to make the parts to a remarkable degree of accuracy and uniformity of spray pattern.

Pintle nozzles operate at moderate injection pressures and give long service.

Mixing by Combustion Energy

Combustion energy itself can be used for mixing purposes. In "precombustion" diesels, the piston provides the energy to drive the air toward the injection nozzle in the precombustion chamber. The resulting air turbulence mixes fuel with air in a very fuel-rich mixture. This is where combustion starts. Then part of the energy of combustion is used to eject the fuel-rich mixture at high velocity and turbulence into the main chamber.

Precombustion-chamber diesels differ from swirl-chamber diesels in two ways: 1. The precombustion-chamber diesel uses only a minor part of the clearance volume in the auxiliary chamber, usually only 25 to 30%. 2. In the precombustion-chamber diesel, fuel is injected into the auxiliary chamber; while in the swirl-chamber diesel, fuel is injected into the main chamber, although it may reach into the auxiliary chamber.

With the precombustion diesel, the energy of the fuel jet is of relatively small importance. A large single orifice nozzle is sufficient. Peak injection pressures are low.

On the other hand, the sizes, proportions, and relationship of the two clearance chambers are critical. In order to create high gas velocity and turbulent flow from one chamber to the other, the passage connecting the two chambers must be quite small. When the proportions are right, the precombustion-chamber diesel utilizes a very high percentage of the air charge and maintains a clean combustion system and a clean exhaust.

Because this type uses more of the available air, it burns more fuel and produces a high power output. The price paid for the energy to direct more fuel to air it can burn, is extra heat losses to the combustion chamber walls.

The net result of the higher heat losses and high fuel-consuming ability is favorable. The fuel economy of the precombustion-chamber diesel is very good.

The superior fuel economy is due partly to higher imep. The combustion energy released from the precombustion chamber acts to complete mixing while the piston is still near the top of its stroke. Because mixing is begun so early, the heat released by the last of the fuel to burn can be utilized through a long expansion stroke. The higher maximum imep more than compensates for the energy used to create turbulence. And more complete combustion, completed sooner, largely compensates for the high heat losses.

The precombustion diesel is not too fussy about the shape or atomization of the fuel charge—but it must get enough at the right rate. In one series of tests on a single-cylinder engine, several combinations of pump size and cam rate were tried. Analysis of the data revealed that three combinations operated with almost identical performance. All other combinations were less desirable in one way or another. Further analysis revealed that the duration of delivery of fuel from the pumps of the three optimum systems was identical within a fraction of a camshaft degree. These tests and general experience, too, show that average fuel delivery rate is important.

Builders of 2-stroke diesel engines do not favor the precombustion-chamber type because they suppose it would complicate their main problem: scavenging. They might change their minds if they analyzed how much space the residual gases in the precombustion chamber at the end of one cycle take up in the new-charge end of the next intake stroke.

Take for example the cylinder diagrammed in Fig. 1. The precombustion chamber contains 28% of the clearance volume in an engine with an 18 to 1 compression ratio. But the precombustion chamber contains only 1.7% of the exhaust products at the point in the expansion stroke when the exhaust valve starts to open. By the time the exhaust period has ended and the gases have expanded to atmospheric pressure, the precombustion chamber contains slightly under 0.6% by weight of the exhaust gases.

The total exhaust gases weigh only about 5% more than the inlet charge. Therefore, the weight of the burned gases left in the precombustion chamber still represents only 0.6% of the new charge in the cylinder.

This small volume of hot gas left in the precombustion chamber at the start of the intake stroke

is rapidly cooled by radiation to the water-jacketed chamber walls. As the residual gas cools, it pulls into its chamber part of the cool air in the main chamber. Cooling of the residual gas is accelerated until it occupies a volume essentially in proportion to its very small relative weight.

The breathing loss is insignificant in comparison to the loss in scavenging flow which usually accompanies the reduction in effective intake-port area when ports are inclined to produce cylinder swirl.

The precombustion-chamber diesel has been unfairly discriminated against on another count. Builders of high-speed engines have assumed that the precombustion-chamber engine would have too great an ignition lag for high-speed use.

Carefully instrumented tests revealed that ignition lag of the properly designed precombustion-chamber diesel continues to shorten as engine speed increases. The tests indicated no low limit of ignition lag for fuel of a given cetane value, even at 3000 rpm.

A study of the ignition lag in various types of diesels showed that because of increased turbulence, hotter chamber surfaces, increased injection energy, or a combination of all three, the period

of ignition delay varies essentially inversely with speed. And the precombustion-chamber diesel is no exception. In fact, with straight amyl nitrate as the fuel, ignition lags as low as 0.00025 sec - 3 deg of crank rotation at 2000 rpm - were measured.

The investigators settled the question of whether ignition lag precludes use of precombustion-chamber designs for high speeds by running a small aircooled precombustion-chamber diesel up to 4800 rpm without difficulty or change in pump-timing setting from that required at 2000 rpm.

This little engine proved the value of the precombustion-chamber idea. The ratio of combustion-space wall area to volume - and therefore of heat loss to fuel burned - was very high because the engine had a 2 $\frac{1}{4}$ -in. bore and a 2 $\frac{3}{4}$ -in. stroke. It required a compression ratio of at least 22 to 1 to start the engine. Yet in spite of the effect of heat losses on imep and the effect of both heat losses and high compression ratio on mechanical efficiency, the engine performed nicely at 3600 rpm.

(Complete paper on which this article is based is available from SAE Special Publication Department. Price 25¢ to members, 50¢ to nonmembers.)

PUBLIC WANTS SMALLER, CHEAPER CAR

continued from page 48

costs to make up the difference in the initial cost. So, obviously, major changes in the present cars in the low price field, based on lightweight metals, are impractical.

It Can Be Done

The suggestion of another engineer, however, can be accepted with some degree of enthusiasm. His opinions are as follows:

- Wheelbase: If the engine is forward, 103-in. wheelbase would be his choice. If the engine is in the rear, the wheelbase should be around 114 in.
- Tread: While this depends on styling and passenger space distribution, he would select 63 in. front and 56 in. rear tread with the engine forward and 53 in. front and 60 in. rear if the engine is mounted in the rear.
- Engine Weight: 350 lb. This would be without transmission and clutch, but would include all electrical and engine accessories.
- Curb Weight: 2200 lb.
- Horsepower: 60 hp with a 5-passenger car.
- Seating Capacity: 3 front and 2 rear.
- Retail Price: \$300 less than present low price cars.

- Maintenance and Operating Cost: 25% less.
- Life of Car: 5 years.

Because banks and finance companies play so important a role in the distribution of motor vehicles, I felt that the opinion of this group might prove beneficial in analyzing the potentials of a smaller, lighter car and in creating a new, lower price class. Therefore, I sent a questionnaire to 243 of the leading bankers in the United States, as well as to leading finance company managers. I received a 25% response. The questions asked were first, whether they believed a small, light car class should be introduced by the automotive industry.

Of the replies, two-thirds said "yes." Out of this same group 60% stated the reason for their belief was based on the fact that car prices at present are too high to assure large volume production for several years.

In answer to the question of what average monthly payments should be on new car purchases to assure a maximum volume of sales, opinions ranged from \$35 to \$75 per month, with the majority indicating between \$40 and \$50.

(Complete paper on which this article is based is available from SAE Special Publication Department. Price: 25¢ to members, 50¢ to nonmembers.)

EXCERPTS FROM A PAPER* BY

Edward Warner

President of the Council, ICAO

INTERNATIONAL

INTERNATIONAL civil air regulations do not exist, although a great deal of work to achieve this goal has been done during the past 25 years. Nearest approach to actual international regulations was achieved at the Chicago Convention on Civil Aviation when each of the contracting nations undertook to keep its own "rules of the air" uniform with the rules established by that Convention and as revised from time to time.

Standardization in these and other matters begins at home and spreads outward. Because of the basic laws establishing and maintaining the sovereignty of the nations of the world, there can be no direct and immediate compulsion upon individuals to comply with any rule except by subsequent action by the governments of the nations.

The International Civil Aviation Organization seeks to achieve international uniformity of air regulations by presenting to some 70 nations internationally-prepared advice on technical and other phases of standardization. Forty-three nations have ratified the International Convention on Civil Aviation, and thereby have undertaken to listen to such advice with particular attention and respect.

Members of ICAO are subject to various kinds and degrees of encouragement to act upon advice presented, and to adopt national regulations or amend them as necessary to keep them in accord with those internationally proposed. They have pledged themselves to follow this advice on "rules of the air" to the greatest possible extent.

Self-interest of every nation in avoiding confusion in its air space furnishes a strong impulse toward acceptance of rules of the air generally accepted by other countries. But there is no guarantee that a new international proposal will enter universally into effect, or even throughout the territory of the contracting nations, still less that it would do so at the same moment in all parts of the world.

Nations have also agreed to give notice whenever they cannot adopt regulations in agreement

with an international standard, thus permitting ICAO to notify the world.

It may reasonably be supposed that the advantages of international unanimity in air regulations will be so generally appreciated that nations will be reluctant to stand before the world in the position of habitually ignoring international recommendations.

I am optimistic enough to expect that national governments will make earnest effort to find means of adopting the international action into their national practice, in order that they may not find themselves in that position.

Another provision of the Convention comes nearer to endowing certain types of international action with mandatory force, in guaranteeing other member countries the right of free flight and landing only on the condition that the aircraft used and the personnel that fly them measure up to the pertinent standards adopted by ICAO.

Some fear that the Civil Aviation Convention is far too weak, and believe it should have been so drawn that the nations accepting it would have obligated themselves to immediate enforcement within their own territory of the exact regulatory texts internationally adopted. Others—and I am among them—feel that in the present state of development such a provision would entail more risk than it would be worth.

The risk that regulations would automatically become effective, in the last detail, in parts of the world where local conditions might make them inappropriate, is a large one. In turn the Convention might well become unacceptable to nations that might be unwilling now to bind themselves to compliance with a regulation in which they might not have concurred.

Even in the United States we have constitutional objections against giving automatic status of federal law to regulations adopted by an international body. If there is to be real progress toward international government, such constitutional difficulties will have to be surmounted.

Under present procedure any proposals for international standardization are first brought before one of the ICAO divisions, each of which covers a broad section of aeronautics, such as personnel

* Paper "Problems of International Standardization of Civil Air Regulations" presented at the SAE National Air Transport Engineering Meeting, Kansas City, Mo., Dec. 1, 1947

AIR REGULATIONS

licensing, airworthiness, rules of the air and traffic controls, or communications. These international groups are made up of experts in each of the fields, and in the future will be meeting once every two years. Division members receive drafts of proposed regulations or changes three months in advance of the meeting to permit careful study by the various interested groups or agencies in each of the countries.

Prepared in three languages, these Division reports are distributed to all the contracting nations for study during the ensuing 90 days. With comments from various governments, these are then studied by the ICAO's Air Navigation Committee, and thence sent to the Council. If they receive approval by two-thirds of the membership of the full Council, they have almost attained the status of standards. During the next 90 days individual nations may declare themselves on the action taken. If a majority of the contracting countries expresses disapproval within these 90 days, the action is nullified and the proposed text never attains standard status.

It is almost inconceivable that half of ICAO's contracting nations would individually express disapproval of anything approved by two-thirds of the Council. The principal effect of this last 90 day period will be to cause a delay.

A regulatory proposal could become an international standard within one or two years under this succession of actions, depending upon whether the proposal is initiated at just the right time to get into the documentation of a coming meeting of the proper Division, or whether it is so badly timed that it would have to wait a year before the next session.

To meet some immediate need, such as to amend an airworthiness regulation made urgent by some accident, the ICAO Air Navigation Committee has the power to take the question directly to the ICAO Council. This procedure might, upon the Committee's recommendation, shorten the time to as little as 30 days. This would be subject to a possible, but improbable, disapproval of more than half the nations.

As in the United States, ICAO has two general types of standards. One resembles the Civil Air

Regulations, provisions of which are endowed with the force of law. The other is similar to substantial portions of manuals issued by the CAA.

There are none of the former's limits on the power of national governments to amend or publish books of recommended practice, lacking specific mandatory effect.

Local airport rules in all parts of the world will be necessary because of unusual conformations of terrain, some of which require a right-hand turn after take-off instead of the customary left-hand circuit.

If the ICAO Council asks the Member States to give notice in every case of adoption of supplementary or local regulations, they will with few, if any, exceptions do so. If each Division of nationally-designated specialists that meets to discuss these problems from time to time will include specific note of supplementary national action which seems to them might be necessary, this would have a great influence on national action.

It would be too much to expect perfect compliance, because some governments would feel that their special problems had not been properly weighed by the Division in framing their recommendation.

But I would expect a high degree of compliance, and a correspondingly important measure of simplification of the regulatory problems faced by internationally-wandering pilots.

Differences in national habits of people or in nationally established practices are inherent difficulties in international standardization. It has yet to be proven that keeping to the left or keeping to the right, as a universal motoring practice, is superior to the other. Even if no problems of changes in mechanical equipment were involved, it would be an enormous undertaking to get millions of people accustomed to one way of doing it to switch to the other.

It is infinitely easier to secure international agreement on such matters as airworthiness before nations have made their diverse choices and their people have become accustomed to them than to gain unification after diversity has become general practice.

Differences in climate, terrain, average distance

between airports, in complexity of ground organizations, radio guidance, and the density of traffic is another embarrassment to uniformity of regulations.

Optional clauses in rules of the air must be drawn in such a way as to cause no actual conflict between the same rules without these clauses and those with them.

Differences in the degree of technical development in one nation as compared with another have their effect on internationally-acceptable regulations. Although they may be felt to some extent in flight regulations and procedures, notably in those relating to air traffic control, their major effect is likely to be on the determination of the qualifications of personnel.

ICAO's Personnel Licensing Division has recom-

mended that airline transport pilots' certificates should be given only to pilots with at least 1200 flight hours, including 50 hr of instrument flight, and at least 100 hr of night flying. International standards must be set high enough to provide proper protection to passengers, but an eye must be kept to the windward to see that such provisions must not be so severe as to handicap countries without a supply of qualified personnel.

In such a case, the international standard would be a compromise, although any nation would set its own standards at a high level. But any such elevated standard should not be a condition upon the entry of foreign personnel into its air space.

(Complete paper on which this article is based is available from SAE Special Publications Department. Price 25¢ to members, 50¢ to nonmembers.)

NEW SOFTER TIRES FOR CARS

continued from p. 28

crease cornering power and slightly retard tread wear; penalty here is worse ride and fatigue-failure tendency in tire shoulder area.

Taking full advantage of the potential improvement with extra low pressure tires also demands that the car designer select proper size tires for each weight of car. It holds for both tire and car performance. Excessively overloaded tires speed tread wear and invite premature tire failures. It

decreases cornering power and general stability while front-tire wear and tire squeal get worse.

Best results, experience shows, come from using an average load per tire that's close to 0% overload. No overload greater than 6% on any wheel or 4% on the average wheel load should be considered. A 6% overload is at least one-half the additional load capacity of the next larger size tire.

The 24-psi inflation pressure, predicated on use of close-to-recommended loads, is urged for extra low pressure tires. But since optimum performance results from tire deflections at recommended

loads and inflation pressures, any great departure from standard calls for an inflation pressure adjustment. Tire & Rim Association standard on load-inflation pressure combinations for the new tires are shown in Table-4.

Maintaining proper inflation pressures is the touchstone to realization of soft-tire advantages. It can't be overemphasized because conventional tire pressures—from 28 to 32 psi—nullify performance gains offered by the extra low pressure tire. A big job lies ahead for the tire industry in educating dealers, garages, and service stations that the new tire wants no more than 24 psi inflation pressure. Tire and car manufacturers must take steps such as marking proper pressure on the tire brand, through bulletins, on tags on the dash of new cars, and in instruction manuals to drive home the point.

The tire inflation problem brings to the fore a situation the industry may have to face sooner or later. It's the need for differentiating between cold and hot inflation since we're now more concerned with improved ride and car handling.

Pressure rise in tire from cold to hot varies from 3 to 10 psi. It's high time for the tire industry to develop some practical method of controlling this inconsistency, at least partially.

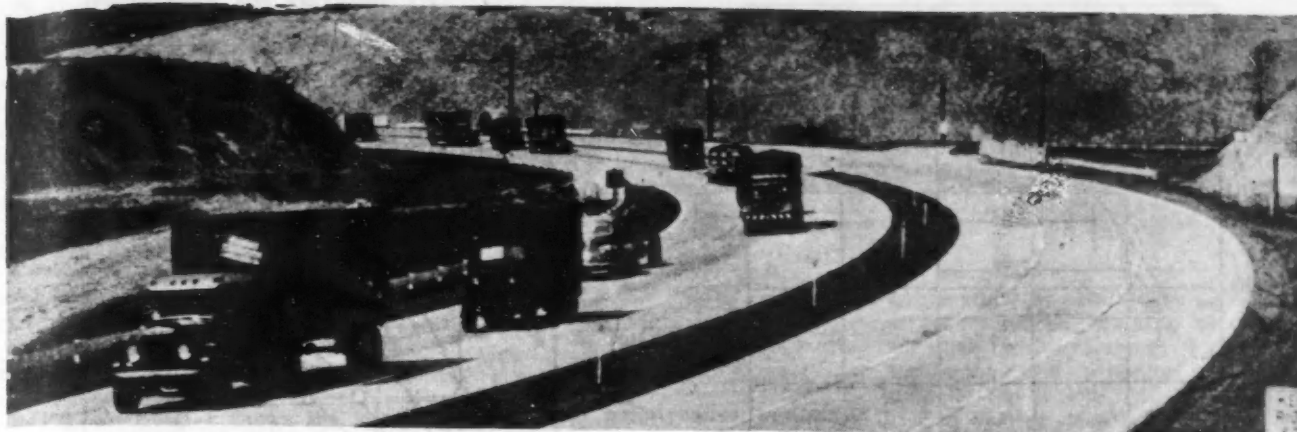
Starting point might be agreement on correct inflation pressure such as 24 psi when cold, 26 psi warm, and 28 psi hot. Some might argue over when is cold warm, when is warm hot. But at least it's better than present practice which completely disregards temperature and pressure build-up.

(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members. 50¢ to nonmembers.)

Table 4 - Loads and Inflation Recommended for Extra Low Pressure Tires

Tire Size	Ply Rating	Loads at Various Inflation Pressures						
		18	20	22	24	26	28	30
6.40-15	4	695	740	785	825*			
	6	695	740	785	825*	865	905	940*
6.70-15	4	775	825	875	920*			
	6	775	825	875	920*	965	1010	1050*
7.10-15	4	835	890	940	990*			
	6	835	890	940	990*	1040	1085	1130*
7.80-15	4	920	980	1035	1090*			
	6	920	980	1035	1090*	1140	1190	1240*
8.20-15	4	1035	1100	1165	1225*			
	6	1035	1100	1165	1225*	1285	1340	1395*
8.90-15	4	1190	1270	1340	1410	1480	1545	1610*
	6	1190	1270	1340	1410	1480	1545	1610*

* Maximum recommended load.



SAE National

Transportation Meeting

The Bellevue-Stratford
Philadelphia

MARCH 30-31
APRIL 1

TUESDAY, MARCH 30

10:00 a.m. TRUCK AND BUS

F. W. Kateley, Chairman

Providing Safe Transportation in Buses

- K. L. Raymond, GMC Truck and Coach Division, General Motors Corp.

Prepared Discussion

2:00 p.m. TRANSPORTATION AND MAINTENANCE

Charles Hudson, Chairman

Operating Experience with Weight Reducing Materials in Vehicle Design

- J. L. S. Snead, Jr., Consolidated Freightways, Inc.

Prepared Discussion

WEDNESDAY, MARCH 31

9:30 a.m. TRANSPORTATION AND MAINTENANCE

M. E. Nuttala, Chairman

Electrical Equipment and Its Application

- J. H. Bolles, Delco-Remy Division, General Motors Corp.

Prepared Discussion

2:00 p.m. TRUCK AND BUS

J. G. Moxey, Jr., Chairman

Fuel Injection for Spark Ignited Automotive Engines

- G. M. Lange and C. W. Van Overbeke, Ex-Cell-O Corp.

Prepared Discussion

5:30-6:30 p.m.

CLOVER ROOM, FIRST FLOOR

Social Hour sponsored by the SAE Philadelphia Section

6:30 p.m.
Wednesday

DINNER

BALLROOM

R. J. S. Pigott, SAE President

SPEAKER: HENRY G. WEAVER

General Motors Corp.

"MAINSRING—the Story of Human Progress and How NOT to Prevent It"

THURSDAY, APRIL 1

9:30 a.m. TRUCK AND BUS

C. A. Scharfenberg, Chairman

High Temperature Cooling Systems

- F. M. Young, Young Radiator Co.

Prepared Discussion

2:00 p.m. TRANSPORTATION AND MAINTENANCE

G. W. Laurie, Chairman

Experience with Apprentice Mechanic Training

- A. W. Neumann, The Willett Co.

Prepared Discussion



MARCH, 1948

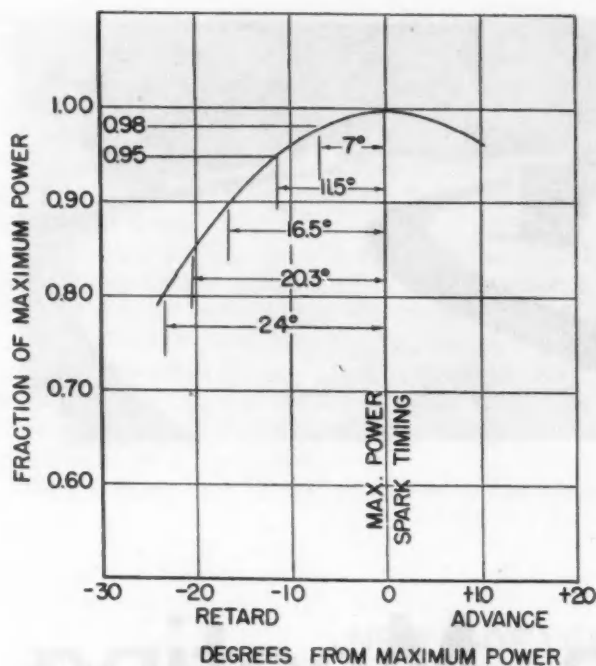


Fig. 1—This curve showing effect of spark timing on full throttle power is a composite of all the cars tested. According to the curve, it's reasonable to assume spark timing for maximum power to be the spark timing for 98% of maximum power plus 7 deg

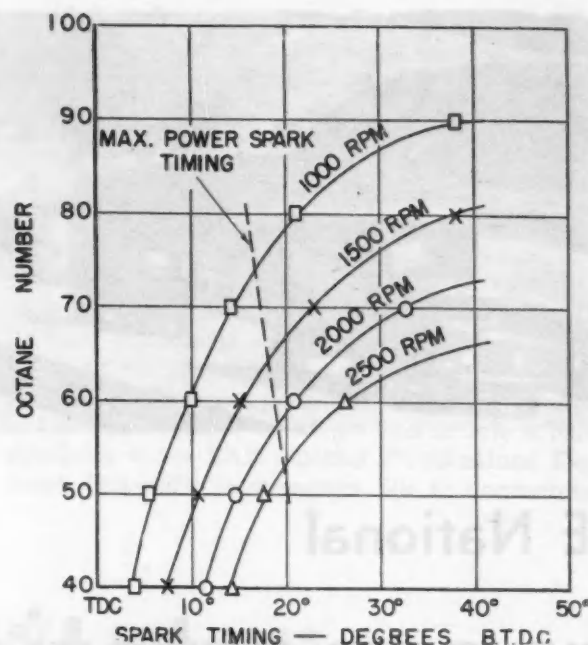


Fig. 2—Tests on one car showing spark timing versus octane number for different values of rpm

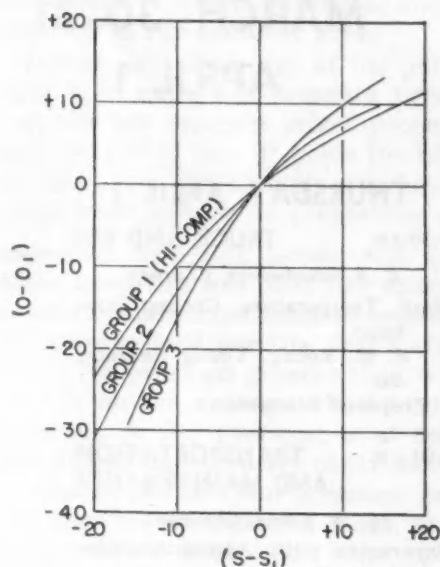
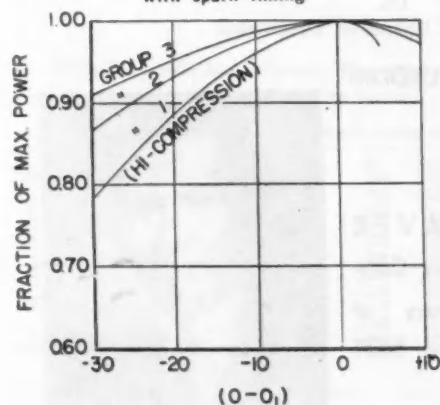


Fig. 3—Average change of octane requirement with spark timing



Relate Spark Advance To Car Octane Needs

Based on paper

By EVERETT M. BARBER

The Texas Co.

(This paper will be published in full in SAE Quarterly Transactions)

KNOCK-LIMITED performance tests of 24 passenger cars—including 1939, 1940, 1941, and 1942 models, some with higher-than-normal compression ratios—showed effects of spark timing on performance to be quite similar for all cars tested.

For one, trend of power change with spark timing was nearly the same for all cars. According to test results, from about 15 deg retard to 15 deg advance from the spark timing for 98% of maximum imep, variations of imep with spark timing is about the same for all speeds. Fig. 1 is a composite curve that's a representative average for all cars tested at all speeds.

While it's hard to determine accurately spark timing for maximum power, the curve shows it nearly equal to spark timing for 98% power plus 7

deg. This provides a reproducible means for determining maximum-power spark timing.

Plotting spark advance versus octane requirement for several engine rpm's also discloses a certain degree of regularity. See Fig. 2. These curves have the form of a hyperbola of the following expression:

$$O-O_1 = \frac{(S-S_1)}{A-B(S-S_1)}$$

where:

O is the octane requirement at the spark advance S;

O₁ and S₁ are the octane requirement and spark advance for maximum power;

A and B are empirical constants.

It turns out that constants A and B are substantially independent of engine rpm. Therefore, the family of curves becomes a single curve when replotted as (O-O₁) versus (S-S₁).

Such curves were prepared for each test car. In every case the data for all speeds form a reasonably good single curve. All the curves retain the general hyperbola form, but differ some-

Fig. 4—Reduction of power resulting from spark retard to prevent knocking on fuels of octane number less than that for maximum power

what in overall slope and curvature. (Constants A and B vary.)

Inspection of the curves discloses no systematic rule for predicting curvature from known engine characteristics. But constants A and B do fall into three groups which give average curves shown in Fig. 3. The groups are:

- Group 1—the high compression engines.

- Group 2—the overhead valve engines with standard compression ratios.

- Group 3—balance of the engines which are L-head designs with standard compression ratios.

In Fig. 3, Group 1 shows the least and Group 3 the greatest reduction of octane requirement with spark retard. It seems that the grouping depends to some extent on octane level and on some function of combustion chamber design.

Combining loss of power from retarded spark operation, Fig. 1, with reduction in octane requirement with spark retardation, Fig. 3, produces Fig. 4. These curves portray loss in power incurred by retarding spark timing to permit operation at incipient knock on fuel having octane numbers other than maximum power octane need.

Note that all the standard engines, Groups 2 and 3, experience only nominal power reduction on fuels considerably below the maximum power octane requirement. High compression-ratio engines in Group 1 are less tolerant of operation on fuel octane numbers less than maximum power octane requirement. (Paper, "The Knock-Limited Performance of Several Automobile Engines," was presented at SAE Metropolitan Section, New York, June 11, 1946.)

Journal Index

A complete index covering the twelve 1947 issues (Vol. 55) of the SAE Journal will be available as soon as the typesetters' strike has been settled

Facts + Judgment = Maintenance Economy

Digest of paper

By A. T. COLWELL

Thompson Products, Inc.

SCIENTIFIC maintenance tempered by common sense will pay dividends to truck and bus operator. He should systematize his operations from the time he selects the vehicle to the decision to retire it.

Choosing the correct vehicle for the job is like buying a pair of shoes. If it doesn't fit, you pay a penalty in every move you make with it. The vehicle must have the right capacity, power, and axle ratio to bring the greatest return per operating dollar.

It pays the operator to spend a little time in determining the needs of his particular operation before he buys a new truck or bus. This will save him dollars and headaches during the vehicle's life.

Even with the right vehicle, maintenance costs will take a big bite out of profits if drivers abuse it. Driver selection and training are being given increasingly greater recognition as reducers of both accidents and excessive wear and tear.

In equipping the maintenance shop itself, good judgment must dictate tools, inspection devices, and other equipment for any particular operation. For example, large fleets could profitably use chassis and engine dynamometers. A two-year study by the Ethyl Corp. and the St. Louis Public Service Co. showed a chassis dynamometer made possible fuel economy increases of from 8 to 10%. This can save the operator \$125 to \$150 per coach per year.

If the operation warrants mechanized handling equipment, it will cut down labor costs; precision machine tools will produce better and cheaper repairs. But the operator must use discretion. He can quickly put his operation in the "red" by going overboard on time and money-saving "gadgets."

It's essential in scientific maintenance that each vehicle gets preventive maintenance. This spreads repair work over the vehicle's life and helps avoid costly emergency repairs and rebuilding.

To insure this periodic care, the work should be done on a well-established schedule and not on a catch-as-catch-can basis. Preventive maintenance

might be summed up as a series of well-balanced checking procedures together with cleaning, lubricating, tightening, and adjusting parts and units of the vehicle.

This system does not eliminate repairs and overhaul; it makes them less frequent and exploits each part to its fullest.

Long-range economy is another part-science part-judgment type of maintenance consideration. Discarding parts only partially worn at overhaul is often long-range economy. Higher first cost for good fuel and oil may be cheaper in the long run. And spending a few dollars in a comfortable seat, ventilation, temperature controls, and defrosters can pay dividends many times greater than the initial investment.

Scientific approach to vehicle maintenance stems from maintenance of accurate cumulative costs. Such figures tell the operator when the total cost curve—total operating, maintenance, and depreciation costs—exceeds cost of a new vehicle plus its depreciation. That's about the time to replace the old one.

But no one formula works for every operator. Too many variables dependent on the type of operation enter into the retirement equation. Safety and economy are some of the factors to contend with. Here the individual operator must exercise judgment in determining what best suits his own case. (Paper "Scientific Maintenance," was presented at the SAE National West Coast Transportation & Maintenance Meeting, Los Angeles, Aug. 27, 1947.)

Few Cockpit Gadgets Ruled for Supersonics

Based on paper

LT.-COM. G. W. HOOVER

U. S. Navy

Special Devices Center

PRESENT-DAY aircraft instrument and control complexity must give way to simplicity if the supersonic pilot is to remain the master of his craft.

Retaining the 300 different valves,

knobs switches, and instruments in modern cockpits will not provide the pilot with split-second control and information needed at 1000-mph speeds.

Take the simple navigation problem of determining location. It's at least a 2 min. job. The pilot must check outside temperature and altitude, correct indicated airspeed, use several computers, and hold a steady course and speed in the process. When he gets the answer he's no longer there. At 1000 mph he flew 33 miles in those 2 min.

And if he has to contend with 18 instruments on the panel, it may take him 12 sec to check them all. It'll be at least a minute before he can make the right move if one dial spells trouble. At faster-than-sound speeds it may be too late.

Engineers must devise a cockpit configuration in keeping with human limitations. If today's researchers achieve their goal, the airplane of tomorrow will have only two basic controls, two to four instruments, and about ten selector switches. (Paper "The Pilot Versus Supersonic Speeds," was presented at SAE Metropolitan Section. Sept. 17, 1947.)

Oil Analysis Big Help In Diesel Maintenance

Based on paper

By CLIFFORD R. STEWART

Faber Laboratories

LIKE the physician, the diesel engine shop man is a diagnostician who uncovers trouble causes from effects. But he too must rely on laboratory analysis (of the used crankcase oil) to find and check some troubles in early stages before much damage is done.

Here are some malfunctions the diesel maintenance specialist can diagnose himself:

For example, he knows a rough-running, noisy engine spells too early injection. The fuel reaches the combustion chamber before the air charge has been compressed to a sufficiently-high temperature to ignite the fuel. Excessive fuel injected before burning leads to a heavy explosion at ignition. It creates extremely high pressure and temperature which cause bearing failure, ring sticking, and ring land breakage.

If law-enforcement authorities tag the diesel-powered truck with a smoke ticket, too late injection is the reason. Allowing insufficient time for all the fuel to burn, deposits excessive soot and fuel residue on the engine and shoots a greasy smoke plume from the

exhaust stack. But if the engine still exhausts fine-assessing smoke despite proper injection adjustment, look to cowboy-driving tactics as the trouble maker.

Even with proper injection timing, it may run rough under load. This symptom coupled with a whitish or light blue exhaust smoke during idling tells the shop trouble-shooter injectors are not balanced. They must be equalized to deliver the same amount of fuel. Otherwise, the cylinders getting too much fuel assume the work burden and wear and break down more rapidly; the under-fueled cylinders miss at idling speeds so that crankcase oil becomes diluted, gum and varnish form on pistons.

These and other troubles the good mechanic can detect because their symptoms are unmistakable and they lose little time in making themselves felt. But in other cases just the opposite is true. The malfunction rears its head only when it's too late, unless laboratory oil analysis nips it in the bud.

Take oil consumption, for example. It's not always possible to maintain reasonable oil consumption, even with proper piston-ring seal

A lighter oil deposits less carbon on evaporation and keeps the rings in better condition. But a thinner oil carrying fuel soot will evaporate more readily and leave suspended soot behind as carbon deposits in the ring section.

The laboratory analysis discloses actual operating viscosity of the oil, percentage of fuel dilution, quantity of fuel soot and carbon in oil, and percentage of oil and fuel gums. It's the only reliable guide both to necessary adjustments and corrections for improving engine performance and to proper oil change periods.

Bearings are another item: where laboratory oil analysis can supplement good maintenance and avert costly failures. Foreign particles imbedded in soft bearing metal create high spots. Added friction at these points accumulates heat, the bearing can't expand laterally, the heated metal expands upward and breaks away from its backing. These particles circulate with the lubricating oil, weld themselves to other bearing surfaces, and repeat the cycle.

Presence of bearing metal in an oil sample warns the operator to make an immediate check for its source. This can stop one bad "apple" from spoiling the whole "bushel." Without an oil analysis, the whole bushel might have deteriorated before the culprit had been detected and arrested. (Paper, "Diesel Engine Maintenance Problems and Assistance from Crankcase Oil Analysis," was presented at SAE No. Calif. Section, Fresno, Oct. 6, 1947.)

New Manufacturing Tech

Based on paper

By JOSEPH GESCHELIN

Automotive Industries

INDUSTRIAL management is on the threshold of an era of greater productivity at lower costs than ever before if it will take advantage of the cost-reducing potential inherent in new machinery and methods. Recent experience of one car maker and the new Monarch "Uni-Matic" are examples of such typical advances now within reach.

Integrating engineering and manufacturing know-how together with new methods, new equipment, plant rearrangement, and redesign of parts paid off a leading car manufacturer by doubling and tripling output in many operations. Table 1 shows the gains he made in five specific cases.

One of many possibilities in advanced machinery aimed at flexibility and high output is the Monarch Machine Tool Co.'s Uni-Matic turning machine, sketched in Fig. 1.

It consists essentially of two members. One is a simplified version of the conventional lathe bed and headstock with change gear, motor, and associated drive. The other part is one or more specially-designed motor-driven tool slides, called Uni-Mats, mounted on Tee-slot swivel bases. This permits turning, facing, and boring operations from almost any angle.

Each Uni-Mat is basically an individual motor-driven compound rest. They may be grouped about the spindle in any arrangement. An electrically-controlled a-c motor on each Uni-Mat traverses the main slide at 100 in. per min until automatically slowed down to a predetermined feed rate.

The entire machine, such as the one illustrated, is controlled electronically from a remotely located cabinet. Only connection between one or more of the Uni-Mats is the cable carrying the control circuits. This makes it possible to position each unit exactly in accordance with its function. (Paper "Latest Developments in Mass Production Techniques in the Automotive Industries," was presented at SAE National Production Meeting, Cleveland, Oct. 20, 1947.)

Techniques Lessen Unit Production Costs

Table 1 - How New Production Techniques Upped Output in One Automobile Plant

Operation	Old Method		New Method	
	Capacity per Hour	Description	Capacity per Hour	Description
Slotting pinch bolt hole in connecting rod	175 per machine	Used plain mill with index fixture, turning rods manually at each cycle of index	600 per machine	A special 4-station Kruger machine handles four rods per station. It's equipped with a trunnion fixture and the heads advance from both ends. The machine loads at one station, saws at two, and unloads at the fourth. Rods are automatically ejected at loading station and discharged into a container ready to be moved to next operation
Finish boring half round in large end of steel connecting rod unit	225 rods	A 6-spindle rail drill drill did the job	525	Now use a 12-spindle rotary Sommers & Adams continuous drilling machine with special automatic locking fixtures and specially-developed boring bars piloted above by roller bearings and a quick-change cutter head. This arrangement also lengthens life of cutter-head blades. The new method yields 900 to 1000 rods per grind against 200 to 300 formerly.
Milling operation on oil pump body cover	85	A 4-spindle drum-type milling machine did this job	168	Raised productivity here with a 2-spindle rough and finish rotary milling machine, and a fixture for automatically clamping and unclamping part
Drilling operation - balance of all operations performed on oil pump body cover	85 with four men	This job requires nine holes drilled and countersunk, one 2-step hole rough and finished counterbored and slot-milled in face. All operations were done in four drill presses and one milling machine	183 with one man	One Kingsbury 6-station indexing flexomatic machine combines all previous operations
Valve stem guide	282 per machine or \$64 with one man running two machines	Turned two steps of OD, chamfered, and faced end with a 1 x 18-in. lathe with honner feed	400 per machine or 900 with one man operating two machines	One 8 x 21 Fay automatic lathe with automatic hopper feed
Exhaust manifold valve body	80 with 9 machines, 100 with 15 machines	Two duplex mills with special 2-spindle carriers, one 2-way Kingsbury, three drill presses, one speed lathe, one Garvin taper, and one 3-way Kingsbury	150 with four machines replacing 15	Used two Ingersoll 2-spindle rotary milling machines, one Kingsbury multiple spindle automatic index machine, and one No. 303 Kingsbury flexomatic automatic index drilling machine

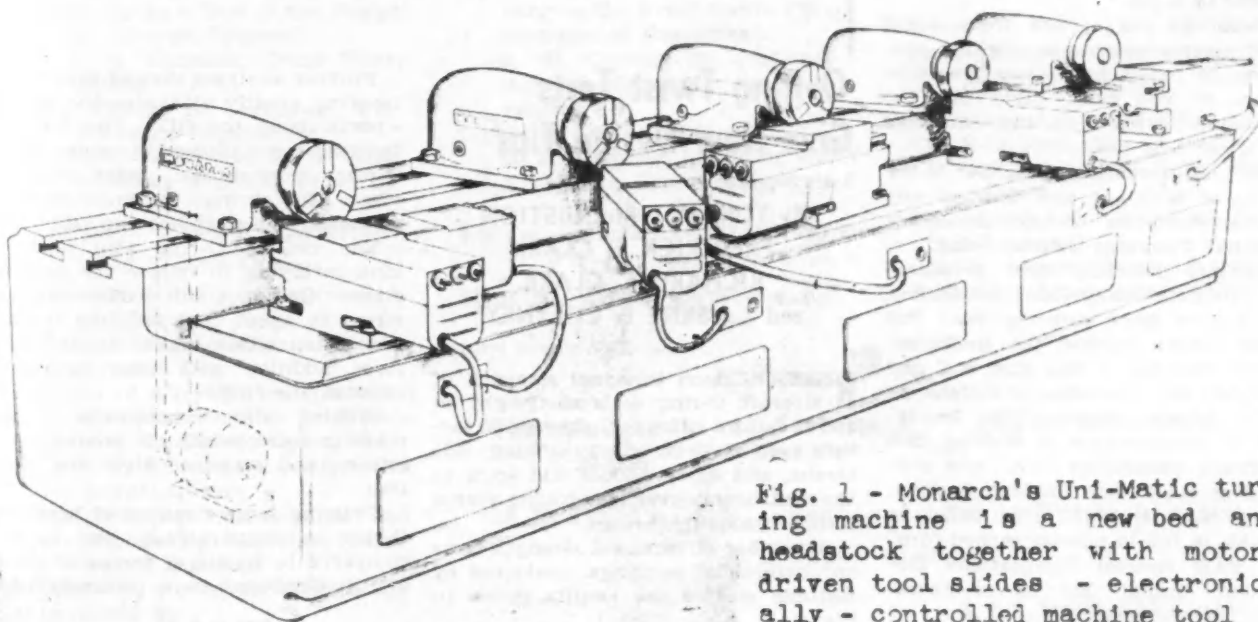


Fig. 1 - Monarch's Uni-Matic turning machine is a new bed and headstock together with motor-driven tool slides - electronically - controlled machine tool

Good Labor Relations Will Cut Fleet Costs

Based on paper

By **HERBERT I. SULLIVAN**

Transportation Consulting Engineer

FLEET men can pluck many dollars from their maintenance costs by giving more attention to labor. Making the mechanic more productive demands understanding of his problems, planning of his work.

Sell the worker on the idea that his job is worth holding. Eliminate hazardous working conditions. And don't expect satisfied, efficient mechanics unless you keep the shop clean, well-heated, free of fumes, properly lighted and ventilated.

Assign your men to the jobs they do best—those satisfied with doing the same work over and over again to repetitive jobs, conscientious and able men to precision work. Treat older workers so they'll feel an obligation to help younger ones do their jobs better.

Never criticize a mechanic in the presence of others. Supervisors must do it in a constructive, kindly manner. Work well done should be rewarded with promotions to better jobs. Establish a definite promotion plan. Make it clear that promotion depends on performance, not favoritism. But don't make promises you can't keep.

Supervisors should lead, not drive men. Jobs must be planned so that each man knows there's another job ready when he completes the one he's on. Otherwise, he'll say to himself, "Since there is nothing else ready, I'm going to look busy until another job shows up. I'm not going to work myself out of a job."

Encourage suggestions from workers for improvements in working conditions, in repair and inspection techniques. If you can't carry out the suggestion, explain to the employee why it can't be done.

Don't let grievances slide. Get to the bottom of each one and clear up any misunderstandings, or take necessary corrective measures without delay.

Carefully selecting new personnel will eliminate many later headaches. It will keep labor turnover low. But by all means release the inefficient worker. Policies of this kind will pay big dividends in boosting maintenance labor's output. (Paper, "The Importance of Maintenance in Making Bus and Truck Operations Pay," was presented at SAE New England Section, Boston, Nov. 4, 1947. This paper is available in full in mimeographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

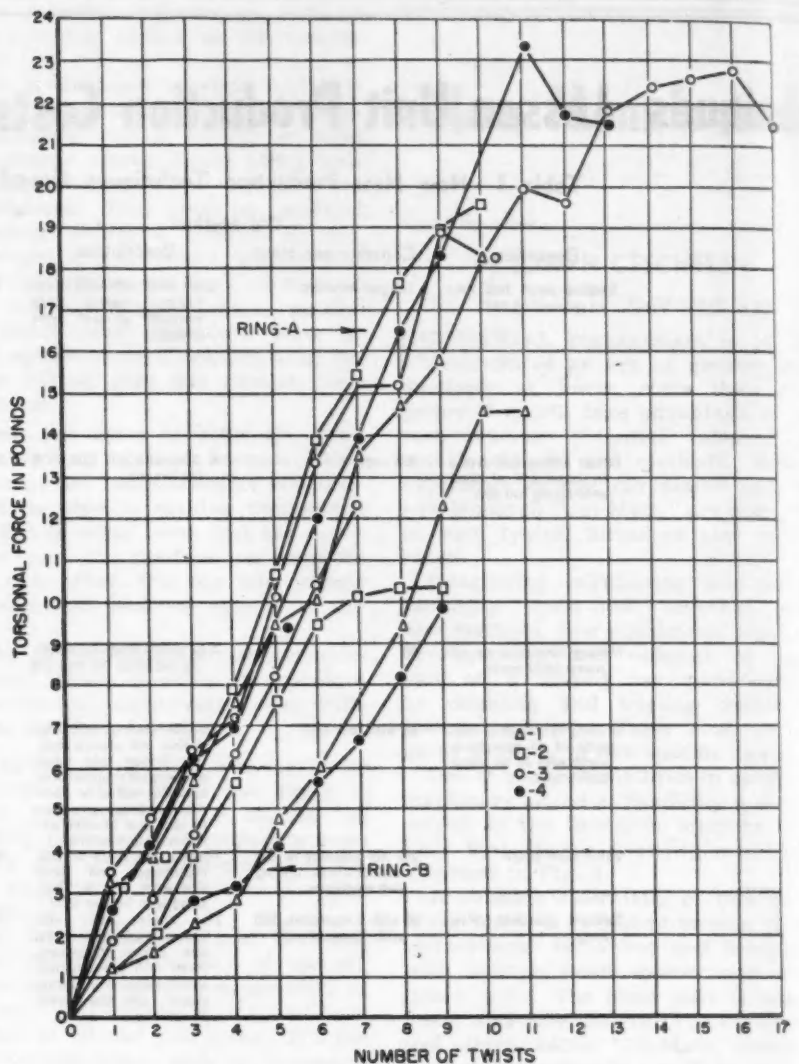


Fig. 1—These results obtained in torsional strength tests on commercial—28 O-rings (1/4 section) helped evaluate twist failure causes

O-Ring Twist Tests Give New Design Tips

Based on paper

By **TOMMY J. McCUISTION**

FREDERICK E. CLARK

RICHARD A. CLARK

and **LaVERNE E. CHEYNEY**

Battelle Memorial Institute

RESearch on torsional strength of aircraft O-ring seals shed light on spiral failure causes. Influence of factors such as twist effect, kinking, side thrust, and aging should add spice to the controversy over free-rolling versus rolling-resistant O-rings.

A number of torsional strength tests on commercial packings conducted by Battelle yielded the results shown in Fig. 1.

Further analyses showed that O-ring twisting greatly elongates the surface—particularly the OD. The torsional twisting force places the center of the O-ring cross-section under compression. This shrinks the cross-sectional diameter and stretches the OD.

The twisted O-ring also tends to kink in trying to relieve the twisting stress. One kink will reduce torsional stress to about that required for one less twist. This makes the twisting force additive with each additional twist of the ring.

Kinking also concentrates O-ring mass in focal points. It promotes extrusion and areas of high local friction.

Twisting force required to break an O-ring is comparatively low—25 lb—compared to frictional forces of about 311 lb developed in a piston-cylinder

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SAE National

Aeronautic and Air Transport Meeting

Hotel New Yorker, New York

APRIL 13-15

TUESDAY, APRIL 13

10:00 a.m. AIRCRAFT

G. L. Bryan, Chairman

What Price Structural Testing?

- S. A. Gordon and G. E. Holback, Glenn L. Martin Co.

Design Charts for Longitudinally Stiffened Wing Compression Panels

- N. F. Dow, National Advisory Committee for Aeronautics

10:00 a.m. POWERPLANT

A. L. Beall, Chairman

Nitromethane as a Monopropellant

- F. Zwicky and C. C. Ross, Aerojet Engineering Corp.

Factors Affecting the Selection of Propellants for Rocket-Powered Aircraft

- T. F. Reinhardt, Bell Aircraft Corp.

The Design and Development of Rocket Powerplants for Aircraft

- A. K. Huse, Reaction Motors, Inc.

2:00 p.m. TRANSPORT

K. R. Ferguson, Chairman

Simplicity as a Goal in the Design of Aircraft Systems

- L. R. Koepnick, Trans World Airline

The Fallacy of Arbitrary Performance Regulations

- R. W. Ayer and F. W. Kolk, American Airlines, Inc.

8:00 p.m. GENERAL POWERPLANT

M. G. Beard, Chairman

Ancestor Worship in Engine Control Design

- R. R. Higginbotham, Republic Aviation Corp.

Survey of Aircraft Powerplant Installation Troubles in Scheduled Air Carrier Operations

- J. W. Baird, Civil Aeronautics Administration

Air Transport Maintenance and Engineering Aspects of Powerplant Controls

- H. W. Nevin, Jr., United Air Lines, Inc.

WEDNESDAY, APRIL 14

9:30 a.m. AIRCRAFT

R. H. Davies, Chairman

Performance of Electrical and Radio Equipment at 40,000 Feet

- Karl Martinez, Boeing Aircraft Co.

The Design of Instrument Dials for Ease of Reading

- W. F. Grether, Aero Medical Laboratory, Wright Field

9:30 a.m. POWERPLANT

A. M. Rothrock, Chairman

Combustion in Moving Air

- F. R. Caldwell, F. W. Ruegg and L. O. Olsen, National Bureau of Standards

The Ideal Temperature Rise Due to the Constant Pressure Combustion of Hydrocarbon Fuels

- N. A. Hall, University of Minnesota, and R. C. Mulready, Research Department, United Aircraft Corp.

2:00 p.m. TRANSPORT

L. A. Rodert, Chairman

Effect of Ice and Heated Air Deicing on the Aerodynamic Performance of Propellers

- B. W. Corson, Jr., National Advisory Committee for Aeronautics

Lightning Effects on Aircraft

- M. M. Newman, Lightning and Transients Research Institute

8:00 p.m. GENERAL TRANSPORT

E. S. Land, Chairman

Some Experiences Pioneering Air

Transportation in Peru

- B. H. Young, Pan American Grace Airways, Inc.

THURSDAY, APRIL 15

9:30 a.m. AIRCRAFT

E. W. "Pop" Cleveland, Chairman

Dynamic Loads in Airplane Structures

- E. S. Jenkins and D. P. C. Pancu, Consolidated Vultee Aircraft Corp.

European Landing Gear Developments

- H. G. Conway, British Messier Ltd.

9:30 a.m. POWERPLANT

F. C. Mock, Chairman

Jet Engine Controls

- A. T. Colwell, Thompson Products, Inc.; F. F. Offner, Offner Products Corp.; and T. R. Thoren, Thompson Products, Inc.

Controls for Gas Turbine Propellers

- R. C. Treseder, Aeroproducts Division, General Motors Corp.

2:00 p.m.

JOINT TRANSPORT AND AIRCRAFT

R. D. Kelly, Chairman

Symposium - Automatic Pilots

The A-12 Gyropilot

- P. Halpert, Sperry Gyroscope Co., Inc.

The PB-10 Automatic Pilot for Air Transport

- P. A. Noxon, Eclipse-Pioneer Division, Bendix Aviation Corp.

Thursday, April 15

6:30 p.m.

DINNER

GRAND BALLROOM

LA MOTTE T. COHU, President, Trans World Airline
Principal Speaker

R. J. S. Pigott, SAE President

Student Branch News

University of Oklahoma

Inspection of turbojet and engine vehicle repair, a War Department film, and a highly educational paper on turbojets were the highlights of a day spent by University of Oklahoma Student Branch members as guests of the Mid-Continent Section on Dec. 5.

High points of the tour included sectioned views of co-axial flow and centrifugal type turbojets, Magnaflux and fluoro-powder methods of detecting flaws, and the assembly line method of complete repair.

At the Section meeting, "A Review of Turbojet and Turbopropjet Developments" was presented by L. E. Shedenhelm and Hope Biggers, of the CAA Aeronautical Center.

Shedenhelm explained the difficulties yet to be overcome before turbojets can be classed in the same high phase of development as the reciprocating engine. High on the list of necessities, he said, are metals to withstand high temperatures and pressures, means of preventing shock waves in compressor sections, and a better fuel.

Contrary to popular belief, he said, the use of the turbojet engine as a source of efficient and general power is a long way off. Use of turbojets is not yet the complete answer to the question of aircraft power, because of their high rate of fuel consumption and slow rate of acceleration at low altitudes and low take-off speeds.

Turbojets may be the answer to higher speeds for aircraft, especially in the sonic and supersonic ranges; however, no concrete predictions can be made until further experimentation is completed.

Results of tests of supercharging automotive engines were reported to Oklahoma Students at their Dec. 12 meeting by a former graduate, Richard B. Sneed, who is technical representative of Ethyl Corp. and chairman of the SAE General Student Committee.

Sneed explained that the problem of supercharging an automobile engine is somewhat different from that of supercharging an aircraft engine, since the aircraft engine operates essentially at constant speed.

Tests were run at variable speeds with a manifold pressure of 10 in. of hg. Some of the results were:

1. Supercharging reduced the required spark advance by approximately 5 deg for maximum power at all speeds. Although exhaust temperatures were increased only slightly, it is still an

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You'll Be Interested to Know

SAE has accepted an invitation to participate in the World Petroleum Congress to be held in the United States in 1950 . . .

James M. Crawford, James C. Zeder, Arthur Nutt and R. D. Kelly started on Jan. 1, 1948, to serve two-year terms as SAE appointees to the Board of Directors of the Coordinating Research Council Inc. . . . Kelly is serving for the first time; Messrs. Crawford, Zeder, and Nutt are re-appointees. Other SAE members of this Board - serving in 1948 the second year of their two-year terms - are: B. B. Bachman, W. S. James, and C. E. Frudden.

American Standards Association constitution has been amended - as favored by SAE - to authorize acceptance by ASA of either State or National incorporation . . . SAE has consistently urged ASA incorporation under State, rather than National, laws and continues to favor such action.

SAE voted against a proposal before the ASA Standard Council to amend ASA by-laws to permit ASA's Correlating Committee to add to its existing function that of acting as sponsor of specific standardizing projects. . . . As a result of SAE and other negative votes, the proposal goes back to ASA Standards Council for discussion.

Another SAE National Production Meeting - consisting of two full days of production clinics - will be held in Cleveland this fall, probably late in October.

SAE Diesel Engine Activity is joining the Tractor and Farm Equipment Activity this year in a National meeting. Result: the SAE National Tractor & Diesel Engine Meeting in Milwaukee, Sept. 7 to 9.

More people (550) attended the session at which W. M. Holaday talked on "Efficient Production and Utilization of Gasoline" than any other 1948 Annual Meeting Session. . . . Passenger Car Activity sponsored this top attraction. Diesel Engine sessions were both in the 400-attendance category, while the Production Session and one F&L session turned out 450. . . . Total attendance at technical sessions was about 3850 - at the dinner, 2290.

More SAE Journal Field Editors do better jobs each year. Requirements in reporting involve regularity, promptness and quality. Fourteen FE's rated tops in all three during 1947. . . . These 14 represented Baltimore, British Columbia, Buffalo, Central Illinois, Cleveland, Detroit, Mid-Continent, Philadelphia, Salt Lake City, Southern New England, Syracuse, Texas, Washington, and Williamsport.

More Sections this year are electing delegates and alternates to the National Nominating Committee and representatives to the Sections Committee at the time the other Section officers are nominated in the Spring. Advantage: No need for a special election in the Autumn.

A "40-Years-Ago" item in the Canton (Ohio) Repository brings news that on Jan. 29, 1908, SAE Past-President Herbert W. Alden was one of three men in a balloon whose basket was dragged 150 ft over jagged rocks before trees finally stopped the large bag. The landing was made in a 2000-ft descent within 5 min - after the aeronauts had traveled 100 miles in 2 hr and 15 min.

H. L. Guy, Secretary, Institution of Mechanical Engineers (British), has been elected to SAE Membership by the SAE Council on an Exchange Secretarial Membership basis. . . . The Institution recently extended an Exchange Secretarial Membership to SAE Secretary and General Manager John A. C. Warner.

SAE Groups, as well as Sections, now have available \$4 per member from the Society for financing their operations. The Groups previously got \$3 per member

MacDONALD

Chosen

Beecroft Lecturer



Thomas H. MacDonald

The world's outstanding authority on highways, Commissioner Thomas H. MacDonald, has been named the Second Annual David Beecroft Memorial Lecturer for "substantial contributions to the safety of traffic involving the use of motor vehicles."

The commissioner of the U. S. Public Roads Administration will present the lecture at a meeting of the SAE Washington Section.

He will be the second of 10 distinguished Americans to be honored during this decade under terms of a bequest to the SAE by its former president, the late David Beecroft.

The nomination of "Chief" MacDonald by the SAE David Beecroft Traffic Safety Engineering Lecture Committee, of which Pyke Johnson, president of the Automotive Safety Foundation is chairman, was approved Jan. 13 by the SAE Past-Presidents Advisory Committee.

Appointed chief of the Bureau of Public Roads of the U. S. Department of Agriculture nearly 30 years ago, the

Beecroft lecturer has devoted a lifetime of energetic achievement to improving the nation's network of highways.

Now a part of the Federal Works Agency, the Public Roads Administration works cooperatively with the state highway departments, providing research facilities on highway design, construction, transportation, and economics as an aid to the proper administration of Federal funds for state aid, and the construction of Federal highways.

Upon the recommendation of Commissioner MacDonald, succeeding congresses have appropriated funds for about 500,000 miles of primary and secondary Federal-aid roads and Federal interstate highways.

A Coloradan by birth, Commissioner MacDonald was graduated in civil engineering from Iowa State College, was named the first highway engineer of that state following several years as professor in his alma mater, became chief engineer of the Iowa Highway Commission and led in the extensive highway program as the first step in his career.

He has won numerous national and international honors for his leadership in highway planning throughout the years.

Members of the Beecroft Traffic Safety Engineering Lecture Committee which selected the 1948 lecturer and organizations they represent are Roy E. Cole, Automobile Manufacturers Association; Norman Damon, Automotive Safety Foundation; C. W. Phillips, American Association of State Highway Officials; Major H. G. Callahan, International Association of Chiefs of Police; H. S. Fairbank, Public Roads Administration, and Otto F. Messner, American Association of Motor Vehicle Administrators.



The late David Beecroft as he appeared in 1921 when he was president of the Society of Automotive Engineers

The Beecroft Memorial Lectures are the result of a \$2500 bequest to the Society by Past-President David Beecroft.

The money was to be used, Beecroft's will specified, "for ten awards of \$250 each to be awarded at the sole discretion of the Past-Presidents Committee with the hope on my part, however, that the awards will be made for meritorious contributions to the improvement of traffic conditions"

The Council, on June 5, 1946, approved the Beecroft Memorial Lectures series recommended by its Past-Presidents Committee as the method of administering the bequest.



WALTER F. ROCKWELL, who is president of the Timken-Detroit Axle Co., Detroit, has been named secretary and treasurer of the Automotive & Aviation Parts Manufacturers Association, Inc. for the year 1948. Rockwell is a member of the SAE Finance Committee. He joined the Society in 1929.



HARVEY S. FIRESTONE, JR., who was president of the Firestone Tire & Rubber Co., was elected chairman (chief executive of the company) at a recent meeting of the board of directors of the company. He has been a member of the SAE since 1938.



BENSON FORD has been elected a vice-president of the Ford Motor Co. and also named director of the Lincoln-Mercury Division. He has been a member of the Ford Board of Directors since 1941, and a member of its Policy Committee since 1946. One of his first jobs with Ford was in the dynamometer room of the experimental engineering laboratories in Dearborn.



RUDOLPH F. GAGG was recently elected president of Air Associates, Inc., manufacturer and distributor of aviation materials and equipment. Gagg had been associated with Wright Aeronautical Corp. since 1930, and for the past seven years has been assistant to the general manager. Prior to his association with Wright, he was assistant chief engineer of Climax Engineering Co., Clinton, Iowa.



THEODORE P. WRIGHT has been appointed president of the Cornell Research Foundation and a vice-president of Cornell University in Ithaca, N. Y. As president of the Research Foundation he will have over-all administrative supervision of the Cornell Aeronautical Laboratory at Buffalo. A member of the SAE since 1928, Wright was formerly head of the Civil Aeronautics Administration.



STANWOOD W. SPARROW has been elected vice-president in charge of engineering at the Studebaker Corp., succeeding **ROY E. COLE**, who is retiring. Sparrow joined

Studebaker's engineering staff in 1926 and in 1937 was named chief of research and development. He later became chief executive assistant to Cole. During the war he was in charge of production testing of Studebaker-built aircraft engines. Sparrow is a new member of the SAE Technical Board. Cole is a past vice-president of the SAE, and was a member of the SAE War Engineering Board, and a member of the SAE Technical Board from the time of its formation until his retirement.

About

JOSEPH GESCHELIN, past vice-president of the SAE, addressed the senior class of the Industrial College of the Armed Forces in Washington, D. C., on Feb. 10. The subject of the talk was on industrial preparedness with emphasis on the problems and requirements of automotive mass production in this picture.

No longer employed by the Ford Motor Co. of Canada, Ltd., **E. L. SIMPSON** has become managing director and chief engineer of the Continental Model Railways, Ltd., Windsor, Ont.

FRANK B. DOYLE recently became director of research for the Guardite Corp. in Chicago.

Now assistant to the chief engineer of Ernest C. Janson, Builder, Inc., in Springfield, Ohio, **JOHN W. JANSON** had been research engineer with the Battelle Memorial Institute, Columbus, Ohio.

Prior to becoming powerplant engineer in the Construction Department of Donovan, Inc., in St. Paul, Minn., **ROBERT M. GEISENHEYNER** was an aeronautical research scientist with the National Advisory Committee for Aeronautics in Cleveland.

Prior to becoming project engineer, **FRANKLIN H. FOWLER, JR.**, of Lessells and Associates in Boston, Mass., was a structures engineer with Curtiss-Wright Corp., Propeller Division in Caldwell, N. J.

The American Foundrymen's Association has awarded a gold medal to **R. G. McELWEE** in recognition of his contributions to the castings industry. He is manager of the Foundry Alloy Division for Vanadium Corp. of America in Detroit.

JAMES H. DOOLITTLE, vice-president and director of the Shell Union Oil Corp., has been presented an honorary fellowship in the Institute of the Aeronautical Sciences. **W. G. LUNDQUIST**, chief engineer of Wright Aeronautical Corp., was among several who were presented fellowships in the Institute.



Members

PAUL G. HOFFMAN, president of the Studebaker Corp., has been elected a director of Time, Inc.

M. M. BURGESS, president of Sheller Mfg. Corp., announced the acquisition by his company of Dryden Rubber Co., organized in Chicago in 1901. They manufacture a wide line of rubber products.

CHARLES HOLLERITH, vice-president both of Hayes Industries, Inc., and of Aeroquip Corp., has been elected executive vice-president of Lake State Products Co. of Jackson, Mich.

No longer executive vice-president of the S. K. Wellman Co. in Cleveland, Ohio, **JAMES R. NURNEY** is owner of Associated Sales Engineers in Washington, D. C.

DR. ALY SHOEB is now technical manager of the Misr Engineering & Car Co. in Cairo, Egypt. Prior to this post, he was general manager with the Egyptian Road Transport Co. in Alexandria, Egypt.

J. P. TRETTON, JR., was recently appointed general superintendent of shops and rolling stock for Indianapolis Railways, Inc., Indianapolis, Ind.

ROBERT F. LYBECK, of the New England Sales Division of Esso Standard Oil Co. (formerly Colonial-Beacon Oil Co.), has just been elected vice-president of the Aeronautic Association of Boston, a chapter of the National Aeronautic Association.

ALLAN RAE was recently appointed Toronto branch manager of A. Schrader's Son Division of the Scovill Mfg. Co. of Brooklyn, N. Y. He joined the Schrader Canadian organization in 1935 and has been assistant Toronto branch manager for the past ten years. Previous to that he was associated with the Sales Department of the Dunlop Tire & Rubber Goods Co., Ltd., for 13 years.

ROBERT F. NOSTRANT is now a junior engineer with Shell Oil Co., Inc., in Martinez, Calif.

L. H. SMITH, for the past eight months consulting engineer and for seven years prior to that vice-president in charge of engineering, General American Aerocoach Co., East Chicago, Ind., has announced the severing of all Aerocoach connections.

No longer a field service engineer for the Wilson Mechanical Instrument Co., covering the Mich. territory, **CHARLES W. SMITH** has become chief development engineer with this company in Bridgeport, Conn.

No longer an experimental test engineer with Lycoming Division of Avco Corp., Williamsport, Pa., **PHILIP H. WALKER** has become a designer with the ACF-Brill Motors Co. in Philadelphia. Walker was publicity chairman of the SAE Williamsport Group in 1946.

Now in the employ of Cushman Motor Works, Inc., Lincoln, Nebr., as a director of engineering, **WALTER R. WESTPHAL** had been an engineer in the Research Department at Willys-Overland Motors, Inc., Toledo.

Heretofore connected with the Hall Mfg. Co. in Toledo, Ohio, **ROBERT S. BEVERLIN** has now become a sales engineer for the City Auto Stamping Co., same city.

CLIFTON A. WARNER, director of procurement engineering of the Research Division, Continental Aviation & Engineering Corp. in Detroit, has resigned this position. He had been associated with Continental for seven years.

Until recently a major general in the U. S. Army, **STEPHEN G. HENRY** has been appointed special assistant to the vice-president and general manager of Ethyl Corp., Baton Rouge, La.

Formerly an engineer with P. R. Mallory & Co. in Indianapolis, **HERBERT E. OLES** has accepted a similar position with the American Machine & Foundry Co. in Buffalo, N. Y.

ALDEN B. CARDER recently became project coordinator in charge of Murac, Calif., operations for the Douglas Aircraft Co., Inc. Prior to this post he was assistant director of flight operations for the company.

Formerly assistant to the owner at the Reg Beezley Auto Service, Memphis, Tenn., **DUFF GREEN, JR.**, recently became district service representative of the Memphis District for the Kaiser-Frazer Sales Corp.

JOHN K. RUDD recently resigned his post as project engineer at Wright Aeronautical Corp., Wood-Ridge, N. J., to study the principles of scientific management, production and quality control as a graduate student at New York University.

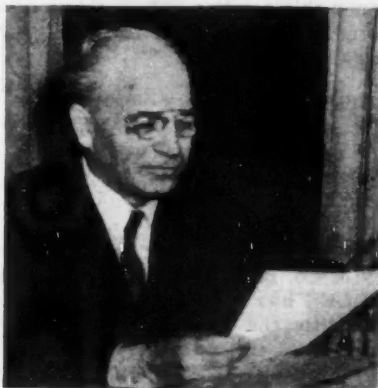
Recently named consulting engineer for the Lamson & Sessions Co. in Cleveland, **HARRY de LAPOTTERIE** had been district manager in Mich. for this company. He has also opened an office at 36 E. Mason St., Santa Barbara, Calif., for the research and development of special screw thread connections, particularly as a consultant in automotive screw thread practices.

PAUL W. LITCHFIELD, left, chairman of the Board, Goodyear Tire & Rubber Co., accepting the eleventh annual award of the National Association of Public Relations Counsel, in New York City on Feb. 3, from **EARLE FERRIS**, president of the Association. He receives this award for his company's sponsorship of the radio program, "The Greatest Story Ever Told." Looking on is **W. AVERELL HARRIMAN**, U. S. Secretary of Commerce

LITCHFIELD IS HONORED



SAE Fathers and Sons

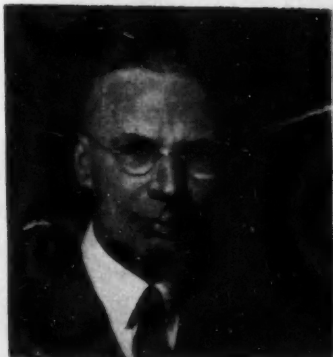


FRANK R. FAGEOL, who has been an SAE member since 1916, with his son **L. J. FAGEOL**. The father has served as chairman of the board at the Twin Coach Co. in Kent, Ohio, from 1945 and the son was recently elected president of this company.



H. J. JOHNSTON is an experimental engineer for the Wisconsin Axle Division of the Timken-Detroit Axle Co. in Oshkosh, Wis. His son, **WILLIAM HENRY JOHNSTON**, is an engineering officer in the Air Forces.

An SAE member since 1925, **ROBERT CRAIG**, with his son, **ROBERT S. CRAIG**, who joined the Society in 1935. The father is a patent attorney with Cooper, Byrne, Dunham, Keith & Dearborn in New York City. Robert S. is affiliated with the Minneapolis-Honeywell Regulator Co.



If any SAE reader knows of SAE Father-and-Son combinations, both of whom are members of the Society, your editors would appreciate hearing from you.

We will write for photographs. Informal pictures of such combinations are preferred to individual formal portraits.

Your cooperation will be deeply appreciated—we don't want to miss any SAE grouping.

SAE Members Said . . .

"We Americans have been free so long that most of us take our free institutions for granted. And in spite of all we read and hear about what is going on in other parts of the world, we can hardly realize what it would be like not to be free" . . . **C. E. WILSON**, president, General Motors Corp., at the 52nd Annual Congress of American Industry, Dec. 5, 1947, in New York City.

"Synthetic rubber production of 275,000 long tons a year, for the next two years is believed the minimum requirement for national security. There will also be required a stockpile of natural rubber which may be as much as 800,000 long tons" . . .

DR. R. P. DINSMORE, vice-president in charge of research and development for the Goodyear Tire & Rubber Co., at the Chemical Engineers' Club in Washington, D. C., on Jan. 13.

CARLETON H. SCHLESMAN was recently appointed division head of the Engineering Department of the Naval Ordnance Laboratory, temporarily located in Washington, D. C. He will soon have permanent headquarters in White Oak, Md. He was formerly an associate manager with the Socony-Vacuum Laboratories in Paulsboro, N. J., having been with this company since 1925 in engineering and research administration capacities.

Senator **RALPH E. FLANDERS** of Vermont, has received the 1948 Washington Award. This award is made annually to an outstanding engineer in the U. S., who has ably served human needs.

United Air Lines, Inc., has moved its Operating Base to Stapleton Airfield, Denver 7, Colo., under Vice-President for Operations **J. A. HERLIHY**. His engineering group will operate as a staff function under **W. C. MENTZER**, the company's general manager for Engineering & Maintenance. **W. W. DAVIES**, chairman of the Chicago Section, is director of engineering. **F. F. DAVIS** is superintendent of aircraft planning and **RAY D. KELLY** is superintendent of engineering development. Project engineers assigned to Davis include **H. B. HUBBARD**, **F. S. NOWLAN**, and **K. H. PELGRIM**. Kelly's project engineers include **C. R. EULO**, **R. L. MCBRIEN**, and **J. E. ROTHMAN**.

L. I. WOOLSON has been appointed operating manager of the De Soto Division of Chrysler Corp., to succeed **GEORGE RUMFORD**, who is retiring to go into business for himself. Rumford had served as operating manager since the start of the De Soto Plant. Woolson joined De Soto in 1936 as chief resident engineer and was promoted to factory manager in 1943.

WALTER D. APPEL, former chief engineer, has been appointed director of purchasing for Willys-Overland Motors, Inc. For many years he was executive engineer with General Motors. He has also served as chief engineer for Vauxhall Motors, Ltd., in Luton, England, and technical director for Adam Opel, A.G. in Russelsheim, Germany.

WILLIAM P. PUTNAM has retired as president of the Detroit Testing Laboratory. He founded this company in 1903 and it was the sole source of chemical assistance for such companies as Cadillac, Ford, Buick, Olds, Durant, Hupp and other automotive concerns.

D. ROY SHOULTS, who was previously chief engineer for the Glenn L. Martin Co. of Baltimore, has been named vice-president in charge of engineering. He had joined the Martin company last June after many years in engineering work for the Bell Aircraft Co. and the General Electric Co.

HAROLD B. FRYE has been appointed chief engineer of the Griffin Lamp Co., Hamilton, Ohio. He had been chief engineer of the K-D Lamp Division of Noma Electric Corp., Cincinnati, Ohio, and chief electrical engineer for the Superior Coach Corp. in Lima, Ohio. He is a past field editor for the SAE Cincinnati Section.

A. D. PUCKETT has joined the E. I. du Pont de Nemours & Co., Petroleum Chemicals Division. He will be in charge of all anti-knock activities in connection with the company's entry into the direct marketing of tetraethyl lead compounds. His headquarters will be located at the Engineering Laboratory at Deepwater Point, N. J.

Previously a district manager with the Union Oil Co. in Spokane, Wash., **RAYMOND I. MAHAN** has been appointed vice-president and general

manager of the Servco Corp. in Long Beach, Calif. In 1945, Mahan was reception chairman of the SAE Southern California Section.





PAUL H. MAURER, former executive engineer of the Redmond Co., Inc., Owosso, Mich., has returned to the company after a three-year absence. He will fill the newly-created post of director of engineering, in which he will be in charge of all engineering work in the company, including research, development and product engineering. Prior to this new post, he was chief engineer for the National Pneumatic Co., Rahway, N. J.



DR. ALBERT E. LOMBARD, JR., engineering consultant for Consolidated Vultee Aircraft Corp., San Diego, will now direct Convair military aircraft sales under the supervision of the vice-president of sales of the company. He will also direct the operation of Convair's Washington and Dayton offices. His aviation career began in 1929 with Curtiss-Wright Aircraft Corp.



JOHN SEAGREN was recently appointed chief engineer of the Atlas Imperial Diesel Engine Co. in Oakland, Calif. Prior to this post, he was affiliated with the American Locomotive Co. at Schenectady, N. Y., as chief engineer of the Diesel Division. Seagren joined the SAE in 1930.



JOHN ST. HORNOW has been appointed by the Department of the Army as superintendent of their Automotive Shops in Manila, P. I. He was recently chief engineer and assembly plant manager for C.N.N.R.A. in Tientsin, China.



COL. GEORGE A. GREEN, for more than 15 years vice-president in charge of engineering and a director of GMC Truck & Coach Mfg. Co., has left for a two-month survey in Africa for the Liberia Co., a resources development concern organized by **EDWARD R. STETTINIUS, JR.** Among the company's directors are **JAMES D. MOONEY**, president of Willys-Overland Motors, Inc. Green joined General Motors following several years as vice-president of the Fifth Avenue Coach Co., New York.

W. McCLIMONT was recently appointed honorary secretary of the Scottish Engineering Students' Association.

The entire organization, formerly known as the Aircraft Research & Development Division, Willys-Overland Motors, Inc., has recently become the Research & Development Division, General Tire & Rubber Co. of Calif., with headquarters in Pasadena. **DR. NORTON B. MOORE** is director of research and development, and **JOE H. TALLEY** is division manager.

On Jan. 27 the President's Certificate of Merit was presented to **V. P. RUMELY**, vice-president of the Crane Co. in Chicago. He received this for outstanding services during the recent war in the field of the manufacture of steel valves for all types of naval vessels.

EDWARD J. WENGER has been appointed general service manager of the Cambridge operations of the Hughes Motor Mart, De Soto-Plymouth dealers in Cambridge and Somerville, Mass. He has been in the automotive service business for more than 25 years.

OGDEN C. SMITH is now service engineer with the Stone Co. in East Rochester, N. Y.

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OBITUARIES

ORVILLE WRIGHT

Forty-five years following the epochal flight of the Wright brothers airplane at Kitty Hawk, N. C., Orville Wright died in his Dayton home after a four-day illness. He was 76. An SAE member since 1916, Wright served in high advisory capacity in both world wars, and was active in aeronautic development work in his laboratory up to four days before his death.

Leaders in the aeronautic industry throughout the world wired and cabled condolences to his family and President Truman said: "... Few men have opened up to mankind such great possibilities for an increasing better world."

A Guggenheim medallist, he had been honored by the world's leading scientific and technical societies as well as by a number of the nation's governments for his aeronautical contributions.

The SAE Wright Brothers Award and the IAS Wright Lectures were established in honor of the late Wilbur and Orville Wright.

RICHARD DEPEW, JR.

A pioneer American aviator, Richard Henry Depew, Jr., passed away on Jan. 28. He was 55.

At the time of his death he was director of domestic sales for the Frank Ambrose Aviation Corp. of Flushing, L. I., N. Y. Prior to this post he had been chief of the aircraft disposal section of the War Assets Administration.

Since becoming a licensed pilot in 1911, Depew had flown more than 100 types of airplane with more than 50 types of engines. He was at the controls of the first Government mail plane on its initial flight at Buffalo on April 13, 1918.

Depew joined the SAE in 1925.

FRANK ALBORN

Frank Alborn, former chief engineer of the White Motor Co., died on Jan. 3. He had been associated with the motor car industry since 1902.

He was with White from 1925 to 1936. Previous to that he was with the former Locomobile Co. of Conn., working on the development of its cars. At least one of these cars was winner of the famed Vanderbilt Cup road race for stock models.

Alborn had been a member of the SAE since 1910.



TECHNICAL COMMITTEE PROGRESS

Switch to H Steels Reported in Survey

Measured by a shop-performance yardstick, both merits and shortcomings

of hardenability bands for steel buying tally up in favor of H steels. This is the conclusion of a survey made within the SAE Iron & Steel Technical Committee by its Hardenability Band Sub-division.

Chief points of interest coming out of the survey are:

- 1. Number of users in H-steel purchasing groups increased from 1 to 14 in the past two years. Some 52% of those who replied use H steels; 30% of the others use some form of hardenability; the remaining 18% still buy to chemical specifications only.
- 2. Some not using H bands claim they're too wide, although this is contrary to evidence on hand. About 93% of steels ordered by any method will be within band limits.
- 3. About 60% of the H-steel users report they experience less rejections for surface and cross-sectional hardness of parts with heat-treating grades.
- 4. Users report another advantage of H steels over former steels—they eliminate very high hardenability heats which give cracking troubles on critical jobs.
- 5. For the heat-treating steels, 60% of users find less change in draw temperatures when using H steels.
- 6. About 60% of the users claim less distortion and 50% experience more uniform distortion with H steels.
- 7. With the exception of the 4000 series and 5100 series steels, there are enough H steels available to cover the demand.

SAE TECHNICAL BOARD

J. C. Zeder, Chairman

W. G. Ainsley	William Littlewood
B. B. Bachman	R. H. McCarroll
W. J. Blanchard	Elmer McCormick
L. Ray Buckendale	Arthur Nutt
J. M. Crawford	G. A. Page, Jr.
W. P. Eddy, Jr.	D. G. Roos
Charles Froesch	C. G. A. Rosen
C. E. Frudden	S. W. Sparrow
W. H. Graves	W. M. Walworth
R. M. Insley	R. L. Weider
G. W. Laurie	D. K. Wilson

V. C. Young



NEW APPOINTEES TO THE SAE TECHNICAL BOARD named by President Pigott are (l. to r.) top row: W.M. Walworth, Chairman J.C. Zeder, and D.K. Wilson; middle row: S.W. Sparrow, W.H. Graves, and Arthur Nutt; bottom row: Charles Froesch, C. E. Frudden, and R.L. Weider. Chairman Zeder will head the Board during the current year. The other new Board members were appointed to serve three years

Zeder Made '48 Head Of Technical Board

JAMES C. ZEDER has been named chairman of the SAE Technical Board for 1948. Chairman of Chrysler Corp.'s engineering board, Zeder has been a member of the SAE Technical Board since its inception. He was also the originator and chairman of the SAE War Engineering Board, which provided much of the operating experience upon which SAE Technical Board operating policies were later set up. Zeder succeeds retiring Board Chairman A. T. Colwell.

In addition to the new chairman, SAE President Pigott named eight new members to start three-year terms in 1948, as called for in Board regulations. (The rules require retirement of one-third of the Board membership each year.) The new appointees are:

Charles Froesch, Eastern Air Lines, Inc.; C. E. Frudden, Allis Chalmers Mfg. Co.; W. H. Graves, Packard Motor Car Co.; Arthur Nutt, Aircraft Engine Division, Packard Motor Car Co.; S. W. Sparrow, Studebaker Corp.; W. M. Walworth, Mack Mfg. Co.; R. L. Weider, The White Motor Co.; and D. K. Wilson, New York Power & Light Corp.

Board members whose term expired at the end of 1947 are: R. E. Cole, Studebaker Corp.; J. H. Hunt, General Motors Corp.; R. D. Kelly, United Airlines, Inc.; C. R. Paton, consultant; A. W. Scarratt, International Harvester Co.; Mac Short, Lockheed Aircraft Corp.; and T. C. Smith, American Telephone & Telegraph Co.

Start Standards Work On Insulation, Paper

JOBBS of setting up both standard insulation-material tests and specifications for paper and cardboard recently were undertaken by the SAE Body Engineering Committee.

Preliminary exploration into the sound-deadener material situation, from the vehicle engineering standpoint, revealed little scientific had been done in either manufacture or use of them. According to L. M. Ball, Chrysler Corp., who will head up this project, considerable savings can be obtained by learning more about acoustical materials and by developing standard tests for them.

Ball expects the program to produce the following gains:

1. Reduction in number and types of materials carried in stock;
2. Simplification of these products;
3. Greater production uniformity;
4. Reduced costs.

Body engineers on the parent committee are aiming for performance specifications for other nonmetallic materials—paper, cardboard, and fiber. A subcommittee assigned to the job, under J. W. Greig, Woodall Industries, Inc., hopes to set up specifications with which the designer can select materials according to physical and service requirements rather than by trade name.

The subcommittee will start with plain fiber board and go up through asphalt products.

Liaison on both these projects will be maintained with W. M. Phillips, General Motors Corp., who is chairman of the SAE Non-Metallic Materials Committee.

Probe Personal Plane Stall Indicator Needs

CONCERNED over the accident potential in stalling of light airplanes, the CAA has requested the SAE (through the Aircraft Industries Association) to study requirements for stall-warning instrumentation for personal aircraft.

Personal-airplane pilots flying by the seat of their pants say they can detect approaching stall condition; but recent tests of over 250 pilots show it isn't so. These results lead industry people to believe that all personal airplanes, not stall-proofed, may eventually be required to fly with stall indicators as standard equipment.

Big factor in stalling seems to be unfamiliarity with the airplane. Those CAA-sponsored tests showed pilots stall much less frequently in airplanes familiar to them.

SAE's Aircraft Instruments Com-

mittee, chairmanned by R. L. McBrien, United Air Lines, Inc., is now developing requirements for a stall warning indicator for personal aircraft. The conferees also are examining the possibility of using such instruments in commercial air transports.

CORRECTION. . . In the article "SAE Engineers to Probe Surface Finish Standards, pp. 51,52 of the February, 1948 SAE Journal, it was erroneously reported that G. Carvelli, Wright Aeronautical Corp., headed the SAE Surface Finish Project Committee. Chairman of the Committee is A. F. Underwood, Research Laboratories Division, GMC, who wrote the group's report to the SAE Technical Board.

Announce New SAE Specs For Batteries, Spark Plugs

A NEW preignition rating for ground-vehicle spark plugs and a revised battery standard recently were approved by the Technical Board for publication in the 1948 SAE Handbook.

The new plug-rating practice prescribes a 17.6 laboratory engine operated under standard conditions for the rating test. Here's how the rating test is run:

Mixture strength is maintained to get maximum thermal plug temperature. Boost pressure is increased until the charge preignites. Boost pressure is then decreased in 1-in. Hg increments until the plug operates continuously without preignition. The IMEP value for this boost pressure becomes the plug rating. After-firing, says the recommended practice, should not be considered failure.

Engineers see this new spark-plug rating method as a real help to engine designers. They now have a performance yardstick to help select the right plug for the engine.

Big changes in the new battery standard are the reduction in number of battery types from six to four and modernization of the battery test specification.

The four renamed SAE battery types, shown in Fig. 1, are the standard, long, reverse, and motorcoach.

CRC Financial Statement

The financial report for the year ended December 31, 1947, of the Coordinating Research Council, Inc., in which the American Petroleum Institute and the Society of Automotive Engineers each have half interests, follows:

Balance Sheet for Year Ended December 31, 1947

Assets:	
Cash	\$103,391
Accounts Receivable	23,554
Deferred Charges	1,452
	<hr/>
	\$128,397
Liabilities:	
Accounts Payable	\$ 8,934
Prepaid Income	9,364
General Reserve	110,099
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	\$128,397

Statement of Income and Expense for Year Ended December 31, 1947

Income:	
American Petroleum Institute.....	\$ 35,000
Society of Automotive Engineers.....	35,000
Military Services, Received and Accrued.....	27,617
Transfers from Restricted Funds.....	24,387
Miscellaneous	6,512
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	\$128,516
Expense:	
Military Services	\$ 20,897
Coordinating Fuel and Equipment Research.....	70,721
Coordinating Lubricants and Equipment Research..	15,848
Equipment Advisory Committee.....	467
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	\$107,933
Income less Expense.....	\$ 20,583

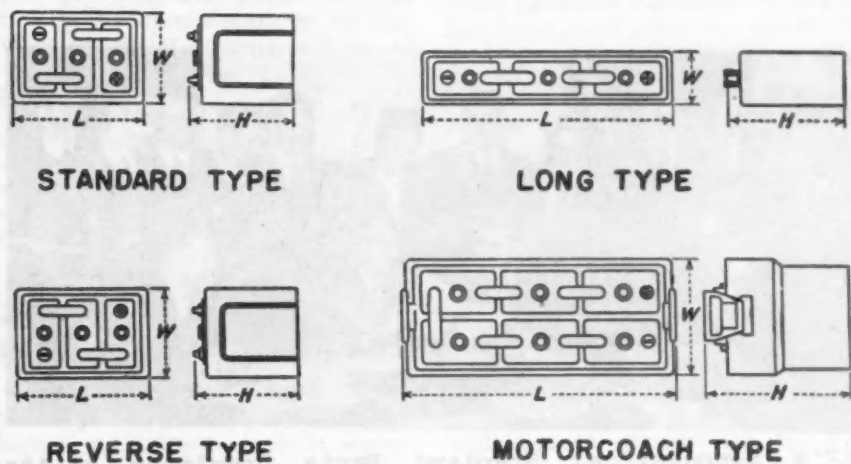


Fig. 1 - These four battery types are included in the revamped SAE Battery Standard that will appear in the 1948 SAE Handbook

SAE Gets Big Aero Standards Job In New Air Force-Navy-Industry Accord

Society Assignment Covers Standards For Engine, Propeller Utility Parts

RECENT industry-military agreement to switch the standards-making job for airplane engine and propeller utility parts from the Air Force and Navy to SAE promises to boost military propeller and engine-building efficiency.

New engine and propeller utility parts standards will now be developed by an SAE committee composed of men from both industry and the Air Force and Navy. The new standards are expected to eliminate much paperwork, time loss, material waste, and rejection because of poor fabrication.

Industry and the Services see the new arrangement as basic to a sound standards program. It gives full consideration both to engineering-manufacturing problems and to military tactical and supply matters.

Industry engineers serving on the Committee will provide the technical know-how. They know how the part is used, what the shop must know to make it. They also can keep standards abreast of technical progress. Committee members from the Services have the knowledge needed to prevent:

1. Unwise use of critical materials.
2. Unnecessarily specialized production tooling which would hamper expansion of production in case of emergency.
3. Design features which would complicate field maintenance or require too-special mechanics' tools.
4. Other design features that would complicate problems of logistics, maintenance, or operations.

The SAE standards will identify

completely in one document utility parts such as nuts, bolts, pipe fittings, and hose clamps. Each standard will be printed on vellum from which blue prints or ozalids can be made directly. It will be assigned an AN number in the AN 9000 to 9999 series, set aside for the utility parts program.

SAE will publish and distribute copies to industry and to the Aeronautical Board Working Committee. The WCAB then will distribute them to military maintenance and supply organizations.

The agreement affirms continued usage by both the Services and industry of SAE Aeronautical Material Specifications covering materials and processes for engines and propellers.

The Society's agreement stemming from the industry-military agreement calls for reorganization of SAE Committee E-25, Standard Parts. Now that all military engine and propeller parts formerly developed by the Services fall under SAE aegis, the Committee's program will be sharply stepped up. Drafts for 75 parts standards are already on the agenda.

Committee membership is being expanded to include Air Force and Bureau of Aeronautics personnel. J. D. Clark, Navy Bureau of Aeronautics, takes over the chairmanship. W. P. English, Ranger Aircraft Engines, becomes vice-chairman.

Serving with Chairman Clark and Vice-Chairman English on the Committee are: W. B. Billingham, Hamilton Standard Propellers; W. F. Bur-

SAE Committee E-25



J.D. Clark,
Chairman



W.P. English,
Vice-Chairman

rows, Aircooled Motors, Inc.; G. N. Cole, Pratt & Whitney; H. W. Epler, Lycoming Division, Aviation Corp.; G. M. Garcina, Allison Division, GMC; A. E. Gibson, Packard Motor Car Co.; W. D. Hazlett, Aeroproducts Division, GMC; R. L. Keene, General Electric Co.; M. E. Mills, Wright Aeronautical Corp.; F. H. Norriss, Westinghouse Electric Corp.; and J. B. Reese, Curtiss-Wright Corp., Propeller Division, and V. E. Newman, Air Materiel Command.

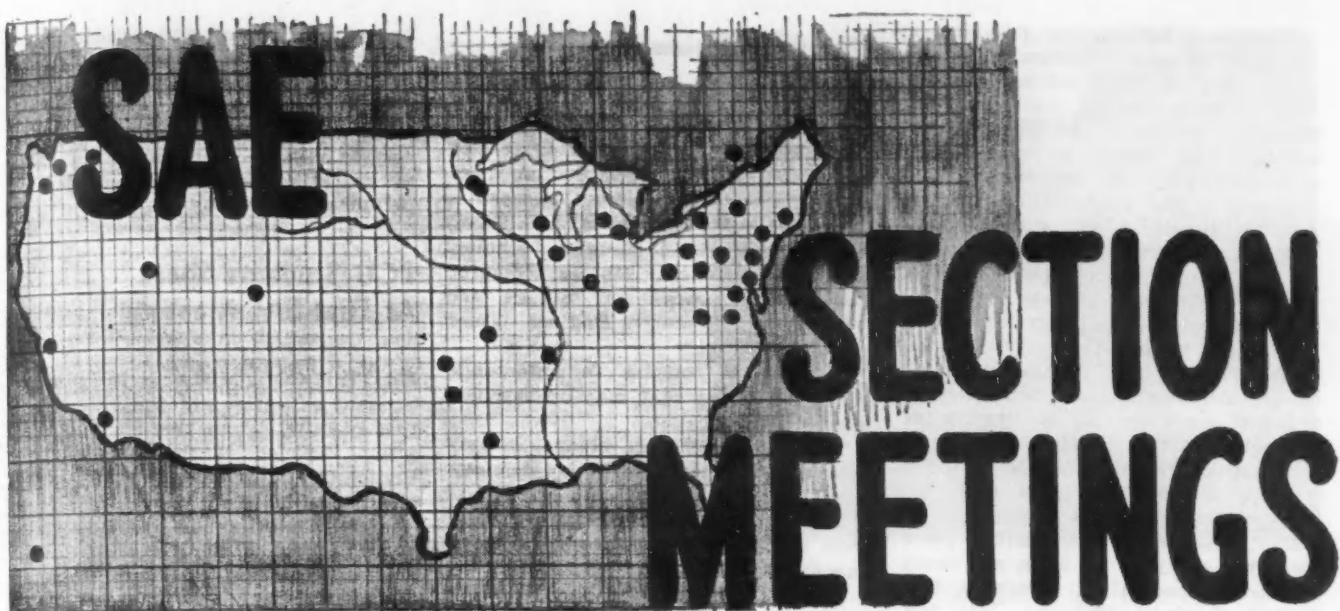
The SAE Aeronautical Materials Specifications Subdivision and its commodity committees, headed by J. B. Johnson, Air Materiel Command, will continue at its present pace.



SAE's Aeronautical Standard Parts Committee, at its first meeting in New York on Feb. 18, laid the groundwork for its extensive standards program covering engine and propeller utility parts

Journal Index

A complete index covering the twelve 1947 issues (Vol. 57) of the SAE Journal will be available to members and subscribers free upon request as soon as the typesetters' strike has been settled.



SAE SECTION MEETINGS

Describes Building Of Roads Old and New

by C. W. SISSMAN, JR., Field Editor
SALT LAKE CITY Group, Dec. 8—George H. Gearhart, of Robinson Machinery Co., told Section members at this meeting how Old World engineers built ancient roads and described some of the problems ahead of modern highway builders. By today's standards, he said, some of the ancient Amorite, Egyptian and Roman roads would probably cost about \$200,000 per mile, with their four carefully-planned layers of well-laid material.

These first roads, he said, were made by excavating a trench the entire length and width of the road, then placing four layers of material in the trench to give it a thickness of about 4 ft. The layers were large flat stones set in lime mortar; small broken stones mixed with lime; still smaller stones, gravel and lime; and a pavement of irregular stones about 6 in. thick, closely joined and carefully fitted.

Most amazing example of road engineering on this Continent was that built by the Incas—4000 miles long across the roughest terrain in the world. It was 25 ft wide, and had sentries located along it so that messages could be transmitted along the entire 4000 miles in only 6 hr.

Road development in this country really began with the start of mail service, but the nineteenth century saw the first organized attempt to improve wagon trails. The Federal Government was in the picture by 1916, but automobiles have progressed at a much faster rate than highways, and as late as 1938 only 33 states had organized state highway departments.

The "road building today" phase of Gearhart's paper was a cross-section

of development of construction equipment. The steam shovel was too cumbersome and expensive to be of value in cross-country road construction—the dump wagon and road hone or grader were greater improvements. The elevator grader of 1893 could almost build a road alone. Wheeled scrapers helped straighten roads and level off grades. Dirt-moving costs have been slashed by wheel and track-type tractors with gasoline and diesel engines, improved scrapers that would dig and haul, and time was cut by improvements in power shovels, off-the-highway dump trucks, and wheel-type, self-propelled scrapers with improved diesel engines.

Further development of earthmoving equipment is essential, Gearhart said, to offset ever-increasing costs of labor and material. Future highway construction offers a challenge not only to the equipment engineer, but also to the engine and power-application engineer.

A film called "Highway Ahead" showed examples of our finest turnpikes and express highways, and indicated what this country's motor highways should have in the way of turns, lighting, safety devices, and so forth.

Suspension Expert Describes Basic Car Springing Problems

by WARREN HASTINGS, Field Editor
CANADIAN Section, Nov. 19—Improvements still to be made in suspensions are of much less significance than strides already made, R. R. Peterson claimed at this meeting. This is attested to, he said, by the universal acclaim with which suspension circles greet any small change in tire pressure.

Peterson, who is on the staff of

Chrysler Corp's Vehicle Suspension Laboratories, analyzed the basic vibration problems confronting suspension engineers concerned with bringing about comfortable ride motions and avoiding or suppressing uncomfortable motions.

Resonance, he said, is a quite tolerable motion when it consists of a sine wave motion at about 60 cpm. When road excitation frequencies are much higher than the natural frequency of the system, as they usually are, a minimum response occurs. When road waves capable of exciting basic ride resonances, equal to those of the system, occur, a violent resonance results. Once started, the simple system tends to continue oscillating indefinitely, necessitating a damping device to dissipate energy introduced by road excitation. With fluid damping supplied by modern shock absorbers, the motion retains its basic sine wave character, amplitudes are reduced and the number of oscillations from a single impulse minimized. The softer the springing, the greater the resonant amplitude for a given excitation, and the greater the importance of damping.

The front and rear sprung car has two other degrees of freedom—pitch and roll. Pitch is customarily minimized by springing the front end more softly, with a lower natural frequency, than the rear, so that when an isolated road bump strikes front and rear wheels in quick succession, the rear end oscillations catch up with the front and the body levels off. With sufficient and carefully adjusted damping, Peterson said, a modern car sprung with about 10 in. static deflection front and 8 in. rear will possess a very agreeable level ride for most road conditions. Bounce will be almost flat, pitching motions held to a minimum, and both frequencies close to 60 cpm.

Right and left springs give the car its third degree of freedom, roll. Roll frequencies of 60 C are not feasible. Soft lateral springing would give too much roll on turns. Peterson pointed out that a car sprung softly enough to give reasonably low bounce and pitch frequencies has to be stiffened up in roll, by means of roll stabilizers, or swaybars, inactive in bounce and pitch but opposing roll motions. Just enough stabilizer action is needed to prevent excessive roll on turns; too much leads to hard-frequency roll motions, particularly on fairly rough roads. Another more difficult answer is better mass distribution around the roll axis, example of which is the current trend toward wider body shells.

There are motions other than the three primary ride motions; for instance, small road irregularities place springing solely on the tires, and cause the body to oscillate at a natural frequency of about 200 cpm. But new extra-low-pressure tires reduce this tire harshness remarkably by increasing static deflection.

Wheel hop (vertical oscillation in an independent suspension) and tramp (one degree of freedom in a solid axle suspension) occur in the vicinity of 600 cpm. Combined

with other secondary system vibrations, they directly and indirectly excite a whole family of low amplitude, high frequency motions, collectively called "the shakes." Shake motions are hard to deal with because, Peterson explained, often the soft mounting necessary to give low natural frequencies is not possible. Only expedient is the poor one of attachments stiff enough to bring about natural frequencies higher than the exciting frequencies.

Shock absorbers give a fair amount of damping for wheel hop and tramp, although secondary damping hasn't nearly the effect of primary damping. Extra-low-pressure tires are particularly successful in reducing shakes: even a small reduction in natural frequency of the secondary masses has a large advantage.

Points Direction For Sludge Cure

by A. M. WATSON, Field Editor

SOUTHERN NEW ENGLAND Section, Feb. 4 - Eighty-five Section members braved a Connecticut blizzard to welcome SAE President R. J. S. Pigott and to hear H. C. Mougey, technical director of General Motors Research Laboratories, speak on "Sludge and Varnish in Automotive Engines - Their Cause and Cure."

Sludge and varnish in automobile engines, Mougey said, may be classified as:

1. Low temperature sludge, largely caused by water formed by burning gasoline;

2. Intermediate temperature sludge, from certain materials present in some gasolines;

3. High temperature sludge, from oxidation of oils not sufficiently resistant.

The four factors that influence these three kinds of sludge are engine design, operating conditions, gasoline, and lubricating oil.

Designs produced by automobile engineers for large production must be able to operate under a wide variety of operating conditions. The car owner, too, must consider his operating conditions. Steps may have to be taken to cause the engine to operate at a higher temperature, if water is condensing in the crankcase or if the gasoline contains too much of the materials that condense on cylinder walls and then oxidize or polymerize to form oil-insoluble products.

It may be difficult, Mougey pointed out, to do much about improving gasoline quality until present problems of production and distribution are solved.

Also difficult is the problem of determining which type of sludge causes the most trouble, or to which of the four factors involved belongs the main responsibility for sludge. However, much has been learned during World War II through cooperative efforts on

the part of the oil and automotive industries. A continuation of this co-operation, plus a proper understanding of these seven various factors, will, he feels, make it possible to obtain good service results over the entire range of operating conditions normally experienced.

BCU Students Speak At First SAE Meeting

by JOHN B. TOMPKINS, Field Editor

BRITISH COLUMBIA Group, Jan. 12 - Student activities got the spotlight at this meeting when the Society's new group enrolled at the University of British Columbia held its first monthly meeting of 1948 in Vancouver's Hotel Georgia. Chairmanned by UBC's young and able Prof. J. R. W. Young, the engineering student speakers discussed problems found in British Columbia's basic agricultural and pulp and paper industries. "Social period" hosts were Vancouver's Truck Parts & Equipment, Ltd., and Truck Tires & Recapping, Ltd.

The first student speaker, D. W. Richardson, discussed power spraying and dusting, herbicides and fungicides. He showed pictures depicting various types of power sprayers and equipment, including a flame unit developed by Pest Control, Ltd.

Second speaker, R. L. I. Fjarlie, gave an excellent account of the investiga-



SOUTHERN NEW ENGLAND. Left (l. to r.): Section Chairman Richard C. Molloy, SAE President R. J. S. Pigott, and W.P. Eddy, Jr., at the Feb. 4 meeting. Above: E. A. Ryder, past SAE vice-president, and technical chairman for the meeting, with Speaker H.C. Mougey

SOUTHERN CALIFORNIA. George James, president of Reaction Research Society, commenting on V-2 and Wac Corporal rockets during the Feb. 5 meeting. Speaker Edward Woll is seated



tional work done on the Alberni Canal (on the west coast of Vancouver Island) prior to the installation of a large pulp mill. The investigation concerned disposal of effluent from the processing of pulp wood into the Alberni Canal safely, to avoid harmful effects on the fish in those waters.

Fjarlie showed slides of the scale model constructed in an exact duplication of the natural canal devised to accelerate the project. He reported findings which indicated the impossibility of discharge of the effluent into the canal from the sulphate plant. The result was a recommendation for changeover of the mill from sulphite to sulphate.

Also included was a demonstration on a new tape-type recorder manufactured by Schroter Electronic, Ltd.

Evaluates Methods To Augment Thrust

by ROBERT V. LINDBERG, Field Editor

SOUTHERN CALIFORNIA Section, Feb. 5—Over 700 members and guests attended this Aircraft Powerplant dinner meeting devoted to turbojet improvements and rocket performance.

Technical Chairman Melvin N. Lefler introduced the principal speaker, Edward Woll, an authority on aircraft-type gas turbines, in charge of combustion research activities for General Electric Co., and the discussion panel: Dr. W. Redding, technical director of North American Aero Physics Laboratory; Wilbur Crater, combustion engineer for Northrop-Hendy Co.; Harold Luskin, research engineer, and Carl Weise, head combustion engineer, both of Douglas Aircraft Co., Inc.

Lefler outlined a brief history of turbojet devices, including their first known beginning in 150 B.C., first patent by English inventors in 1791, Lake's development in 1909, up to the railway gas turbine in 1936, which developed 50,000 rpm at 930 C.

Woll, who prepared and delivered a paper entitled "Turbojet Engine Performance Characteristics with Reference to Methods of Augmentation," explained the obvious military desirability of turbojet propulsion, coupled with the need of a solution to its disadvantages in take-off, acceleration, and lack of maneuverability at high altitudes.

"It is mandatory that the useful range of the turbojet be expanded so that it more than just fulfils military applications where high speed is essential," Woll said. "This can be done by augmenting thrust several different ways:

- "1. Engine overspeed;
- "2. Water injection at the compressor inlet or into the combustion chambers;
- "3. Injection of a refrigerant such as ammonia or carbon dioxide at the compressor inlet;
- "4. 'Bleed-burn' cycle;
- "5. Reheat cycle or tailpipe burning;
- or
- "6. Combinations of these schemes."

Operational limitations and complications of the first four methods were pointed out with diagrams and experience charts. Attention was directed to the fifth as "the most practical" method, where "the lowest specific fuel consumption commensurate with the high thrusts" at higher altitudes are found. Several charts and diagrams were shown to prove visually the point and photographic slides were projected showing the reheat burner in operation. "Daytime operational tests with a 6-ft tailpipe burner 26 in. in diameter burns 14,000 lb of fuel per hr with no visible flame," he said.

Concluding, Woll explained that "the augmentation methods mentioned are simple and direct ways to obtain increased thrust without resorting to the development of new engines." Further usage of these improved methods depends on progress in the field of high-temperature metallurgy.

Discussion centered on altitude performance of tailpipe burning and installation maintenance problems posed by Crater and Weise. Woll agreed that altitude performance on installations similar to tailpipes tested at sea level were 80% as effective, but said that "at high flight speeds the pressure ratio increases as flight speed is accelerated."

"Comparison curves of thrust piston turbosupercharger engines with turbojet show them to be on par at altitudes; reheat produces the increased thrust desired," he said, explaining that the reheat burner at present is intended for take-off, but with considerable development necessary before complete efficiency is attained. Installation maintenance problems of handling 2700 F temperatures which occur at 30% augmentation and above "will be solved in time," Woll said; stainless steel, air cooling, and ceramic coating possibilities are now being improved.

Open meeting question of general interest concerned temperature lubrication and metallurgy questions. Woll said that jet bearings usually are anti-friction type, generally air-stream cooled with kerosene or even hydraulic fluid as lubricant.

George James, president of the Reaction Research Society, gave a running comment on color films of German V-2 rockets—which, he said, often did considerable damage to German territory because of lack of launching control.

James discussed possible mail delivery by V-2 rockets between Los Angeles and San Francisco, whereby at a cost of \$1 per oz deliveries could be made in 10 min with perhaps 45 min total elapsed time between mailing the message and its receipt. However, he remarked drily, two or three days probably would be needed to collect the required minimum of 25 lb.

Explaining the Wac Corporal U. S. Army movies, James reported that "they traveled 43 miles with a 25-lb payload at a speed of 500 to 1000 fps," had a "diameter length ratio of 1 to 12 in." and were 30 ft long.

Films were also shown of the Reaction Society's experiments in nearby desert areas, and mention was made of the U. S. Navy's 230-mile-range Neptune Rocket—scheduled for firings this summer.

Marine General Urges Engineers' Cooperation

by HYMAN FELDMAN, Field Editor

WASHINGTON Section, Jan. 13 - Automotive engineers were urged to continue to bring new ideas to the attention of the Armed Forces when Brig.-Gen. Fred S. Robillard of the U. S. Marine Corps spoke at this meeting. He emphasized particularly the importance of pre-planning and combining ideas.

Robillard told of the development of landing craft by the Armed Forces. The first type used by the Navy was the 50-ft Motor Sailor, a boat able to hit the beach at 7 knots. An anchor had to be thrown out before the beach was reached so that the boat could be winched off the beach after unloading. Robillard described the Beetle Boat, Amphibious Tank, "Y-Boat," 38 and 40 Tank Lighter, and the Higgins boats. Alligator boats were first designed for rescue work in the Everglades, but of 100 Alligators used during the initial landing at Guadalcanal, only three were able to return to the transports after a trip to the beach.

Suggests Fuel Consumed As Maintenance Criterion

by KENNETH G. CUSTER, Field Editor

COLORADO Group, Jan. 27 - "Users of diesel engines are primarily interested in horsepower hours produced," accord-

ing to J. A. Watts, application engineer for Cummins Engine Co., Inc.

Speaking before a joint SAE-ASME meeting, Watts said: "Underpowered vehicles are becoming passé. Some states are even requiring that each vehicle have a definite performance ability. Instead of the trend being toward smaller engines, it is toward larger units. For some time this has been the trend in the West, and now the East is rapidly changing. The need for extra performance in congested areas and the need to maintain higher over-the-road speeds regardless of terrain has greatly influenced this trend. Equipment that is becoming larger and that will run at least 100,000 miles a year makes good engineering design and proper maintenance economical and logical.

"Down time is the most important factor to be considered in any maintenance program. Specifications on engine rebuilding that will determine rebuilding procedure, as well as when parts need to be replaced, becomes an important factor in maintenance. An accounting system of checks and controls becomes a responsibility of the owner. A program of periodic and progressive maintenance is important and must be faithfully followed if down time is to be kept at a minimum.

"A motor's efficiency is influenced by losses. A constant check on all accessory equipment such as fuel pumps, cooling equipment, air cleaners, and oil filters, as well as exhaust back pressure, can increase horsepower out of an engine by as much as 22%. A 10%

loss of power for each 10° F increase in engine temperature on a diesel motor makes the problem of cooling very important. A selection of transmissions with proper speed ratios can also add 10% to the efficiency of a unit."

Watts projected the possibility of a maintenance schedule based on vehicle fuel consumption rather than hours or miles. This type of schedule is possible and very logical, because it overcomes the big factor of varying loads and speeds. Establishment of check points based on gallons of fuel consumed gives the necessary periods of maintenance that will anticipate part failures and prevent emergency failures. Maintenance schedules have been established for engines that are new until they must be completely rebuilt. Rebuilding generally is needed after 50,000 gal of fuel have been consumed.

Watts' discussion was followed by a demonstration by Roy O. Schiebel, district manager of Magnaflex Corp., on the detection of fatigue cracks in metal parts. A tour of the new Cummins service shops in Denver, and a picture showing a new 500-hp experimental truck being tested on the Minnesota Iron Mines, completed the joint program.

Wide-Range Improvements Seen for Future Trucks

by HAROLD B. FRYE, Field Editor

CINCINNATI Section, Jan. 26. - "Good Roads and Highway Transport Make Possible the American Standard of Living." Under this title, Fred B. Lautzenhiser of International Harvester Co. described the vital role of motor transport in the American economy, and made some predictions.

Highway transport will continue to be basic to all other forms of transportation, he feels, because of its flexibility and adaptability that cannot be matched by any other form.

Generally, he predicted, the new trucks that emerge (after production requirements ease up, plant, machine tool, and manufacturing facilities are rehabilitated, and new designs tested) will be lighter but stronger and more durable, giving greater payload for a given gross weight and lowering operating cost and minimizing repair time. Improved relation of loading space to axle location will give better load distribution. There will be better balance and driver handling, and better-equalized tire loads and tire wear that will conserve rubber.

Higher compression ratios and otherwise improved engines will take advantage of the antiknock qualities of the new fuels, and give a greater ratio of power to gross vehicle weight, improved performance, and economy in labor and maintenance costs for powerplants.



COLORADO. Speaker John Watts (left) and Section Past-Chairman Lars O. Prestrud, both of Cummins, inspecting one of Cummins' diesel engines at the Jan. 27 meeting

SAE Section Chairmen

Shown at right are Section Chairmen Clark E. Smith of Salt Lake City, G. Wayne Thomas of Western Michigan, and Robert Kinnebrew of Philadelphia



SMITH

... of Salt Lake City

Clark Edwin Smith began his active mechanical career at the age of 14 when he repaired Model T's and tractors for neighbors when he wasn't working on his father's farm in South Dakota. At 18 he left the farm and started work in a public garage as a mechanic.

One thing led to another, and Ed found himself in Omaha where he spent several years doing automotive electrical and engine rebuilding work. In 1931 he joined Burlington Transportation Co., and some years later became foreman at the Omaha shops.

In 1935 he was transferred to Salt Lake City, and placed in charge of maintenance for the company's Western Division. Since then he has been active in pioneering diesel engines for use in large intercity buses, and has run many tests to prove new ideas and changes of design made by large bus manufacturers.

His hobby, like his work, is mechanical, and he spends many hours with his lathe in the basement.

Since Ed joined the Salt Lake City Group in 1945 he and his ever-present cigars have been an active part of the Group.

—by C. W. Sissman, Jr., Field Editor.

THOMAS

.... of Western Michigan

G. Wayne Thomas has been an SAE member since 1918, and was treasurer of the Section for two years. He is a director of the Internal Combustion Engine Institute and an alternate member of the Continental Engineering Council.

Thomas came to Continental Motors Corp. shortly after Pearl Harbor, and spent 2½ years at its Detroit plant working on tank engines, helping to develop the famous R-975 radial, 450-hp, aircooled engine that powered nearly 50,000 tanks that saw combat duty.

The Army borrowed him for over a year to serve the Ordnance Department as civilian chairman of its Engine Committee.

Before he came to Continental, Thomas was chief engineer of Mack Mfg. Co.'s Light Truck Division, and was chief engineer of Reo Motor Car Co., where he served for 12 years. He was also chief engineer for Duplex Truck Co., designer for Apperson Bros. Motor Car Co., and was with Racine Engineering Co., consultants specializing in farm tractors.

—by George E. Dake, Jr., Field Editor



KINNEBREW

.... of Philadelphia

Bob Kinnebrew is a congenial southern gentleman from Georgia, and the live-wire branch manager of White Motor Co.'s Philadelphia office.

His studies at Georgia Tech were interrupted by the war and service in the Army Air Forces as a lieutenant pilot, but he returned to complete them in 1921 and get his BS in mechanical engineering.

No "rambling wreck," he has risen fast in White's Sales organization since 1922, when he started in the Nashville office. His eminence as a salesman brought him a branch managership, then a transfer to Washington and finally to Philadelphia.

—by A. M. Miley, Field Editor

Also to be expected are automatic transmissions, wide-base rims, and a simplified and more uniformly progressive range of tire capacities.

In addition, he said, there are some new features, systems and principles not yet used to any great extent that may appear. And there are improvements that can be made on existing designs.

Cooling systems should function in response to actual requirements. Demand, he said, is probably more variable than that on the generator, and potential power saving greater. Future answer may be the variable pitch fan or the magnetic or eddy current fan drive.

All-synthetic rubber, 100,000-mile tires can be expected in the not-too-distant future, according to tire manufacturers. Also on the possible list are surge tanks and pressure cooling; a central tire inflation system; air clutches; built-in air conditioning; plastic cab noses; aluminum for wheels and axle housings; improved chassis springs; torque converters, power steering; highly specialized truck and tractor-truck models for special uses.

Additionally, almost certain to be in general use sooner or later are two-way radio; polarized headlighting; ball-loaded bushings; speedometers that tell drivers when to shift; an anthropologically correct, floating driv-

er's seat; an SAE standard practice safety fuel supply tank that can't explode; adjustable fifth wheels to enable instantaneous shifting of load between tractor front and rear axles.

Design will have to be functional: Good for the intended job and economical to suit the owner; safe, easy to handle and good in performance and ride to suit the driver; and accessible and simple to maintain to satisfy mechanics. Price may become less important to the purchaser than functional design.

International Harvester sponsored the pre-meeting refreshment program. Meeting was held at the headquarters building of the Engineering Society

MARCH, 1948

HIGHER OCTANE FUEL RAISES ENGINE COST

by ARNOLD R. OKURO, Field Editor
NEW ENGLAND Section, Feb. 3—
SAE's president for 1948, R. J. S.
Pigott, was principal speaker at this
record-attendance meeting. Continued
interest in the student activity program
conducted by the Student Committee
and supported by individual members
was indicated by the presence of faculty
members and student guests from
Wentworth Institute, Tufts College,
Harvard University, and Franklin
Technical Institute.

Harold P. Davis, Jr., mobile tele-
phone service engineer for Bell Radio-
Telephone, presented a slide film show-
ing the application of radio telephones
in mobile units. This phase of commu-
nication, while not entirely new, is
being expanded for commercial service,
and at present permits two-way con-
versation between a subscriber station
and vehicle operator, and a one-way
signal from the station to the vehicle
operation—who will then call back
from the nearest telephone.

Harry Stanton presented his "News-
cast," featuring highlights of the An-
nual Meeting in Detroit.

Norman G. Shidle delivered a mes-
sage from secretary and general man-
ager John A. C. Warner, and described
the editorial expansion program.

President Pigott spoke on "Develop-
ments in Fuels, Lubricants, and Lubri-
cation," pointing out that recent over-
emphasis on octane rating disregards
the cost involved, and ignores possible
gains in efficiency through other chan-
nels. There are engines designed now,
he said, that would be satisfactory for
passenger service at compression ra-
tios of 7.5 or 8 to 1, using something
like 88 to 93 Research. These designs
show economy gains of a possible 25%
at 8 to 1, 40% at 12.5 to 1—gains ex-
ceeding the cycle gain in efficiency be-
cause of subsidiary effects. Higher
bmep produced makes possible a
smaller engine, that cuts breathing and
mechanical losses, and lower dilution
with products of combustion raises
part-throttle efficiency.

There will be, he feels, a moderate

rate of increase in compression ratio
and octane rating for the next two or
three years, depending on the ability
of the petroleum industry to supply
the right fuel. Highest ratio for a year
or two probably will be 8:1. Meanwhile,
gasoline research aims as much at im-
proving other qualities (such as vola-
tility and stability) as at raising octane
number.

Internal combustion engines have ex-
posed lubricants to high temperatures,
combustion by-products, road dirt, and
a number of other factors that have
steadily increased lubrication problems.
Synthetic lubricants can be made with
viscosity indexes of 150 and better, but
are still deficient in some properties,
and cost about three times as much as
high-grade petroleum oils.

Developments forced during the war,
Pigott said, have been good but not
miraculous. Advances in quality and
performance have been accelerated.
Commercial production of the gas tur-
bine is, in his opinion, the major devel-
opment other than atomic fission. If
the gas turbine were to replace the re-
ciprocating engine to a large extent, he
said, the need for high octane gasoline
would disappear. Gas turbines pose no
new lubricating problems, but extend
two of them—temperature and speed.
Other conditions would be simplified,
because lubrication is not carried on
in the presence of combustion and com-
bustion products.

He urged designers of gas turbines
to consider designing for normal fuel
oils, and to "remember in packing their
hell-fire pinwheel in small space, that
all organic liquids break down by 650 F,
and therefore the lubrication system
should not be treated as a hit-or-miss
auxiliary service, as it was in the re-
ciprocating engine."

EFFICIENT FARMING OWED TO TRACTOR REFINEMENTS

by PETER P. POLKO, Assistant Field Editor
CHICAGO Section, Feb. 10—The farm
tractor industry's responsibility of
manufacturing machines the farmer
wants and needs to improve his pro-
duction was recognized about 50 years
ago, but not until after World War I

did developments in tractors reach the
stage where mechanical farm power
began to meet needs of farmers outside
the grain-growing areas.

Speaking at this Section's tractor
industrial power, and diesel engine
meeting, Lloyd F. Overholt, chief engi-
neer of International Harvester Co.'s
Mechanical Research and Development
Division, told of developments in trac-
tors since the early days of the century,
when tractors were large, heavy, slow-
moving machines useful for pulling
large gang plows, heavy road machin-
ery, and combines, and for driving
threshing machines. These tractors
were expensive to purchase, and their
cost of operation and up-keep were so
high that only farmers operating on a
very large scale could afford them.

Developments were rapid, however,
with the trend toward smaller, more
efficient vehicles, provided with fully
enclosed power trains, more effective
air cleaners for engines—resulting in
longer productive life.

In 1924 the "Farmall" type tractor
was introduced to the market, marking
the beginning of a new era in farm
tractor design and utility. It provided
a machine useful in grain-growing
areas as well as areas devoted largely
to row crops.

Today's farmer has his choice of an
assortment of tractors suitable for
practically any size farm—from the
very largest with thousands of acres,
down to the garden-size farm of a few
acres. Rubber tires, improvement in
power trains, and a wider selection of
operating speeds, and possibility of hy-
draulic torque converters are increas-
ing tractor efficiency constantly; and
noise, vibration, discomfort, and rough-
ness are under attack in efforts to im-
prove driver efficiency as well. Eventu-
ally the engine in the farm tractor will
be as smooth and quiet as an automo-
bile engine with the same number of
cylinders. Improvements will come
through refinements in combustion con-
trol, reduced weight in moving parts,
changes in bore-stroke ratio, and,
where tractor design permits, applica-
tion of rubber mountings.

It is conceivable, Overholt said, that
the tractor of today will lose its iden-
tity in the tractor of tomorrow, and
that the tractor of the future will be
a highly flexible unit with the features
needed to accommodate a multiplicity
of special machines and farming tools.

A. W. Scarratt, formerly vice-presi-
dent of engineering and patents for
International Harvester Co., expressed
his belief that the major effort to re-
duce tractor size was made during the
period 1920 to 1925; subsequent tractor
engineering has been engaged princi-
pally in refinements.

W. H. Worthington, of John Deere
Tractor Co., said that there are three
major considerations involved in pres-
ent-day farm tractor design: safety,
utility, and economy.



CHICAGO. Past-Chairman
W. H. Oldacre (left)
accepting a certifi-
cate from James T.
Greenlee, chairman for
1944-45

Torsional Springing Advantages Outlined

by ROBERT BEST, Field Editor

BUFFALO Section, Jan. 22—Advantages of torsional springs were outlined at this meeting by Ellsworth C. Boeck, president of the Truck Equipment Co., Inc.

Torsional springs, he pointed out, form the only suspension system that suspends by hanging. Structurally, they are the most efficient, since more spring may be secured from a pound of material than by any other method. They are not restricted as to choice of material since steel, rubber, and other materials may be used.

All changes in pivot positions are controlled by the torsion rod resistance. As the axle gets closer to the body, resistance progressively increases, so that it is impossible for the spring to bottom. No bumpers are needed.

In addition, lateral flexibility is provided in the link mechanism so that no lateral thrust is imparted to the body when one wheel is suddenly raised; for instance, in rolling over a bump. On applications having tandem axles a considerable degree of axle pivot action is permitted, allowing wheels track on curves, so that tire mileage is increased. In this connection, one Fruehauf tandem trailer logged 222,000 miles on one set of eight tires using this system.

A torsion spring suspension uses more bearings than a conventional system, and the success of the system depends much on the life of the bearings. Excellent bearings have been developed from synthetic materials which usually will outlive the rest of the equipment, provided the rubbing surface has a low micro-inch finish and dirt is excluded.

Torsional suspensions are lighter than conventional equipment, and braking forces are transmitted independently by each wheel to the frame, giving greatly improved tire performance.

Reports on Development Of Aeromatic Propeller

by JOHN D. WAUGH, Field Editor

BALTIMORE Section, Jan. 13—This meeting featured a paper outlining the process by which Koppers Co.'s Aeromatic propeller hub was redesigned to employ tubular arc welded components and eliminate the previous practice of machining the hub from a solid steel forging. The paper was presented by John D. Waugh of Koppers, who had participated in the preparation of the arc welding paper on Aeromatic propeller technique which won the 1947 James F. Lincoln Arc Welding Founda-

tion's grand award for papers on new welding practices.

The paper reported that the problem originally facing the makers of the Aeromatic propeller was one of retaining a sound hub structure to withstand the forces of vibration, centrifugal force, and gyroscopic actions of the blade—yet reduce the expense of machining hubs from steel billets which were not only expensive but also bore an unnecessary weight penalty. Welded fabrication solved the problem of strength and cost reduction by permitting use of inexpensive seamless steel tubings and small turned parts.

The scheme of operation of the propeller—which has no power unit to rotate the blades, but rather employs the natural forces on the blades and counterweights—permitted a redesign of the former forged hub so that all adjustment parts would be arranged externally. This procedure had been impractical with the forged hub because machining was required to receive parts; with the welded structure, components could be placed wherever desired on the hub and welded in place.

Before the adoption of the arc welding procedure, steel castings and aluminum alloy forgings had been investigated for their lower cost manufacture, but were found to have an incalculable weakness caused by vibration fatigue. The very sound welding process of atomic hydrogen also was tested, but found to be about five times as slow as the arc welding technique. Copper brazing the tubular parts of the hub together was tried, but distortion on cooling, due to unequal sectional areas of the hub, would pull the copper-brazed joint apart before the hub could be finished.

It was disclosed that the 200-hp Aeromatic hub was reduced in weight from 17.8 lb to 12.2 lb—a 31.5% saving for the welded structure over the forged unit. Total cost reduction for this larger hub amounted to a 42.8% saving with arc welding. In the weight-critical, low-horsepower range, the 85 to 165-hp flange model Aeromatic hub was found to weigh only 5.6 lb welded, compared to 8.8 lb when obtained from a forging. The weight saving in this instance amounted to 36.4%. Resulting total weight of 32 lb for as high as 165 hp was noted as being the best weight-horsepower ratio ever recorded for a variable-pitch propeller.

The small hub presented an extraordinary cost saving of 75.5% for the welded over the forged structure. This saving originated with the ease in which complicated shape of the flange hub could be manufactured as compared to the forging, which had defied economical manufacture when machined from a billet.

Summation of the overall benefits of production arc welding Aeromatic

hubs include the fact that the company would save in excess of \$200,000 a year in direct labor and raw material as compared to the forging practice. Use of tubes, drop forgings, and simple machinings, in addition to the inexpensive jigs and fixtures required in welding, attained this cost reduction impossible with any other practical process. External arrangement of adjustment devices provided a more practical mechanism and enabled achievement of a better appearance.

Waugh was assisted in discussion by R. Karey, also of Koppers Co., who had perfected many steps of the welding technique. Numerous questions were asked about the strength of welds and the type of inspection procedure used. The speakers explained that welds are characteristically stronger than the parent metal, and X-ray and ferromagnetic inspection techniques always discover any porosity, slag inclusions, or flaws. The efficacy of other welding methods was described by a resume of the timing figures, which showed that arc welding provides the best weld in the shortest time.

Section Chairman Herman Hollerith, Jr., called attention to the many cut-away welding and forging specimens of the hubs on display at the meeting, and a lively discussion of detail features followed.

"Buy Trucks on Specs, Not Price" Says Bauman

by MURRAY FAHNESTOCK, Field Editor

PITTSBURGH Section, Jan. 27—Over 100 members and guests checked their coats at the Mellon Institute to hear J. N. Bauman, vice-president of White Motor Co., tell how trucks should be bought on "specs" rather than on price. Bauman distributed calculation forms to his audience, and showed the eight steps necessary to calculate the specifications needed to meet requirements. (See SAE Journal, November, 1947, p. 42.)

Technical Chairman K. G. Scantling of Equitable Auto Co. remarked that too many technical papers are limited to the smaller details, and compared them to individual trees. He said it was desirable to get the broader viewpoint, where we could see forest as well as trees.

Charles Woods of West Penn Power Co. agreed that too many trucks have been sold by manufacturers, and bought by users, without making certain that these trucks were definitely fitted for the work expected of them. Regardless of how much engineering has been done at the factory, he said, it is impossible to be certain that any truck is adapted for an individual job, unless all the variations in the opera-

tion have been carefully considered. This can be accomplished only through the medium of experience.

As an example, the question of gear ratios has become so complicated that many operators are at a loss to know whether this reduction should be made in the auxiliary transmission, or in the rear axle. We have at present single reduction in one make of truck up to a certain tonnage. Another make may use double reduction in practically all sizes. Some truck manufacturers recommend higher gears in the transmis-

sion, lower in the differential; others feel this should be reversed.

In Penn Power Co.'s utility business, he said, most manufacturers frown on 2-speed rear axles. But after using them, they have practically standardized on this type for many of their jobs. As an example, one of their line trucks costs between \$9000 and \$10,000, complete with body, and is depreciated over a period of ten years.

A 2-speed rear axle costs about \$275. Consequently they secure the advantages of a 2-speed axle, and 10 speeds

forward, at a cost of about \$2.30 per month, or less than 10¢ a day. He believes this 2-speed rear axle saves more money in gasoline than it costs to use. Labor is saved through better performance on hills, and maneuverability increase helps in setting poles on rough terrain or other off-the-road use.

Another discussor said that in his experience as a fleet operator, his company had experienced more trouble with broken axle shafts when auxiliary transmissions were used than when 2-speed axles were fitted. Bauman replied that if the final gear ratio between engine and wheels was the same, there should be no difference.

Another reported that when an auxiliary transmission was added, the increased torque could cause trouble if it weren't wisely used. But a 2-speed axle may have larger axle shafts.

E. H. Kanarr, of McCrady-Rodgers Co., said that too often the misapplication of trucks to the job was due to a case of mistaken identity. He said that dump trucks too often were most abused from this standpoint, since there are so many uses for them . . . highway construction, strip coal operations, house coal deliveries, and farm applications. The farmer may be excused, to a certain extent, for the average farm cannot afford an automobile and two trucks. So a dump truck is bought and converted to many uses. But where a fleet operator's hauling is more constant as to load and mileage, considerable thought should be given to truck application.

SAE Journal Field Editors

Baltimore - John D. Waugh
Buffalo - Robert Best
Canadian - Warren Hastings
Central Illinois - J.W. Volland
Chicago - J.E. Kline
Cincinnati - Harold B. Frye
Cleveland - Wilson B. Fiske
Dayton - No Appointment
Detroit - W.F. Sherman
Hawaii - Louis M. Eihl
Indiana - Robert T. Jackson
Kansas City - H.F. Twyman
Metropolitan - Charles Foell
Mid-Continent - F.E. DeVore
Milwaukee - Ralph Switzer
New England - Arnold R. Okuro
Northern California - Elton Fox
Northwest - Donald M. Grimes
Oregon - Tom E. Allen
Philadelphia - A.M. Miley
Pittsburgh - Murray Fahnestock
St. Louis - A.K. Miller
San Diego - Rex Taylor
Southern California - R.V. Lindberg
Southern New England - A.M. Watson
Spokane-Intermountain - T.H. Barker
Syracuse - William F. Burrows
Texas - W.E. Lind
Twin City - S. Reed Hedges
Virginia - Jean Y. Ray
Washington - Hyman Feldman
Western Michigan - George E. Dake, Jr.
Wichita - W.A. Day
Williamsport - J.H. Carpenter
British Columbia Group - John B. Tompkins
Colorado Group - Kenneth G. Custer
Mohawk-Hudson Group - No Appointment
Salt Lake City Group - C.W. Sissman, Jr.

Expert Explains Heat-Treat Problems

by ARNOLD R. OKURO, Field Editor

NEW ENGLAND Section, Jan. 6—Speaking before this meeting on heat treatment, and fully aware of the potential aridity of the subject, W. J. Diederichs, metallurgist for The Autocar Co., presented a very interesting and enlightening metallurgical lecture.

Contrasting fluid solutions with solid solutions, he described changes in grain structure resulting from addition of carbon at various temperature stages. Taking exception to a popular assumption that metal parts fail in service due to so-called crystallization, Diederichs explained that all metals are crystalline in structure, and form a definite geometric pattern. Such parts might fail if some abnormal condition developed in service that would alter the grain.

He stressed particularly, for the attention of maintenance operators, the importance of avoiding application of heat, such as a welding flame, to all heat-treated parts, without full familiarity with the initial treatment.

Student Branch News

cont. from p. 62

important fact to be considered by the designer of the valves and exhaust manifold.

2. At a constant speed of 1000 rpm, increasing the manifold pressure decreased the exhaust valve temperature, in some instances, below that of the un-supercharged engine. This was probably a result of forcing air past the exhaust valves during the period when both exhaust and intake valves were open, Sneed said.

3. Supercharging increased the air-fuel ratio from 12.5:1 (normal ratio) to close to 14:1, the theoretical air-fuel ratio for maximum power. In other words, supercharging made possible better distribution of the charge in the cylinder.

Sneed showed on a graph that the percentage of heat lost to cooling water was less in the supercharged engine.

In summary, supercharging offers an appreciable increase in horsepower at the same brake specific fuel consumption; reduction in overall spark advance; and approach to the best theoretical air-fuel ratio, and no appreciable change in exhaust valve temperatures, despite possible large thermal stresses.

In addition, supercharging does not increase the octane number required per horsepower output at as fast a rate as does raising the compression ratio.

—by R. R. Goodwin, Field Editor.

Fenn College

Multiple plant production control methods were described at the Jan. 30 meeting of Fenn College's SAE Branch by Lloyd W. Hackley, superintendent of the production planning department of American Steel and Wire Co.

American Steel and Wire has plants from Worcester, Mass., to Duluth, Minn., broken down into five divisions. Hackley told how plant outputs are controlled and coordinated, and described facets of his job—which is just as likely to be concerned with local personalities as with neighboring plant substitutional production on side-tracked orders.

—by Robert P. Buhrow, Field Editor

California Institute of Technology

Engineering opportunities in oil production were discussed at Caltech Student Branch's Jan. 19 meeting by General Petroleum Corp.'s chief production engineer, Hallen N. Marsh.

In 1869, 10 years after the birth of the oil industry in Pennsylvania, only 20 bbl per day were being produced.

But this grew to 500,000 bbl by 1900, 4,500,000 in 1944, and 5,500,000 today. Petroleum consumption continues to grow, and except for a wartime peak, coal appears to have passed its peak production. Water power still produces a very small part of total power in this country. The United States consumes 62% of the world's supply of oil, and the current oil reserve is about 21,000,000 bbl. Marsh emphasized the fact that oil is being discovered at a rate equal to that at which it is being used, so that there is not yet cause for alarm.

Oil is found in sedimentary deposits, he said, and for this reason regions near the ocean are favored. Drilling is accomplished with a special rock bit, and power is supplied to the bit by sections of pipe added as the bit grinds deeper into the earth. The current record for depth is about 18,000 ft for a well in the Middle West, but a California well was approaching this depth recently and may have passed the mark. Mud cools the bit and carries away particles cut loose. It is pumped down the pipe center and returns between the pipe and the well wall. The entire drilling rig involves auxiliary equipment such as pumps, boilers, cooling towers, brakes, and power units—usually diesel engines.

Five men operate modern drilling units. Either folding or stationary derricks may be used for servicing the well. Other modern developments include directional drilling, particularly useful for extracting oil from under the sea.

Drilling rate varies from 6 in. per day to 1000 ft, depending on the type of crust. Cost may be \$5 to \$10 per foot for a shallow well, about \$100,000 for an 8000-ft well, and may approach \$250,000 for deep wells.

—by Warren Marshall, Secretary

Caltech Student Branch members heard some interesting aspects of aircraft design when they joined the ASME Student Branch to hear a talk by Dr. A. L. Klein, consulting engineer for Douglas Aircraft Co., Inc., and associate professor of Aeronautics at Caltech.

Klein mentioned briefly the three main criteria of good aircraft design: sound fundamental conceptions; good details; and flexibility. But instead of dwelling on these, he devoted most of his talk to less general but more interesting information based on his own experience.

The balance between the slow analytical approach and the swift intuitive approach is a difficult but important one to strike, he said. Disastrous examples of overemphasizing the latter are quite numerous. A good example of overusing the former is the B-19. This giant was started in 1934—and,

because of the completely analytical approach used in its design, was not completed until 1939. Consequently, despite the fact that it was a good airplane that satisfied the requirements for which it was designed, it was obsolete before it rolled out of the hangar. It was slow; it had no sealing tanks; it was too lightly armed; it was underpowered; and it had too low a wing loading.

Giving the specialist too free a hand, too, is dangerous. In the design of the

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DETROIT

DC-6 (as a modification of the DC-4) the aerodynamic specialists wanted to enlarge the flap considerably in order to increase the coefficient of lift and thereby effect an increase of 15,000 lb in the gross lift. But it was found that the center of lift would be moved back considerably, and the wing, fuselage and tail would have to be strengthened to balance the resulting moment. The strengthening members would add at least 14,500 lb to gross weight. Therefore, an increase in net lift of 500 lb

or less would have been bought at the expense of a great deal of operating economy and safety.

A question from one of the students about Howard Hughes' new flying boat caused Klein to digress into an explanation of his antipathy to wood in aircraft design. Wood soaks up water, he said, and thereby gradually decreases the useful load. It is not uniform, because of variations in growing conditions, accidents in growth, and humidity changes. Even the Lockheed Vega, one of the best wood airplanes ever built, has been known to crack in two in hard landings because the wood was brittle. Treated wood is expensive and very difficult to glue. Lastly, it has no scrap value.

Klein closed with some remarks on the importance of weight. He showed how the DC-3, based on prewar economy, was literally worth its useful load in gold to the operator.

—by Joseph W. Wechsler, Chairman

Caltech Student Branch members joined student members of ASME on Dec. 8 to hear an arresting and thought-provoking discussion by Harry Boller (Caltech '38), who told of the operation of his consulting engineering firm.

Eleven engineers and machinists are employed, he said, and in two years he has handled 400 jobs ranging in value from a few dollars to \$20,000. Customers fall into three general categories: private individuals who need assistance; engineering firms that need special equipment; and research organizations that need aid in development projects. Customers may present their problems as completed drawings with all specifications; as general drawings and specifications which the firm must detail; or as oral descriptions of the equipment and what it is to accomplish, leaving the firm to work out methods.

Boller showed slides of some of his interesting projects:

- A rubber tube clamp, developed to meet a need for dependability in administering anaesthetics. A dual clamp finally was made that would accurately control the flow of two liquids without allowing mixing of the two at their supply points.

- An intricate speed selector and control device for pump rpm. The selector and control unit has a cone of gears turned at an accurately known speed, and this speed permits other speeds to be picked from the cone of gears. This selected speed is compared with the speed of a selsyn repeater for the actual rpm of the pump. Any difference is observed by a differential which subtracts the two speeds, and correction is made. The speed selection is made to one-thousandth of the total speed range, a remarkable flexibility. One interesting feature is that the constant frequency for the cone of gears is controlled by a tuning fork. The accu-

racy of the fork is 0.01% when a temperature correction is supplied. Boller cited this instrument as an example of his design philosophy: any instrument can be broken down into compact, individual units. This facilitates assembly, repair, and redesign of a single portion if necessary.

- The "instantaneous heat capacitometer," an instrument developed for the jet propulsion laboratory operated by Caltech. The instrument supplies continuous records of specific heat with increasing temperature. Material to be tested is placed in a nickel-lined furnace that heats to 2600 F. When the temperature of the furnace increases, the temperature of the specimen lags somewhat. At any chosen furnace temperature, the heat required to bring the specimen up to furnace temperature will give a measure of the specific heat. This auxiliary heat is supplied by an element within the specimen, and is measured by the voltmeter method.

Boller presented students with some of the philosophy needed to operate a small engineering firm. Use of quality instruments made by other firms, he said, is a healthy practice. Particularly important are neatness and compactness of design. A parting and helpful suggestion was that of keeping very accurate cost records so that future estimates of job cost may be made with more precision.

—by Warren Marshall, Secretary.

Massachusetts Institute of Technology

Prof. Dean Fales, consulting engineer to General Motors Corp., spoke to M.I.T. Student Branch members at their Jan. 7 meeting on "What to Expect in the Really Postwar Automobile."

Fales first familiarized his audience with early developments in the automobile, particularly in component parts (engine, transmission, chassis, cooling system, clutch). Using this early history as a basis for extrapolation, he pointed out those channels in which any future improvements may be expected to come.

—by Ralph H. Riedel, Field Editor

University of Wisconsin

J. W. Owens, of Fairbanks Morse Co., was speaker at a joint meeting of ASME and SAE Student Branches at the University of Wisconsin, Nov. 5. Owens spoke on "The Evolution of Diesel Engine Weldment Design and Fabrication."

Owens reviewed the long struggle that preceded establishment of the welding process in industry. Over the years, experiments proved the possibility and economic desirability of all-welded structures. World War II demonstrated conclusively the superiority of all-welded structures, since no other

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method of fabrication could have yielded the great number of ships produced.

Although initial designing cost of a welded motor block may be greater, he said, overall cost will be less than that of a cast block. In addition, a defective welded structure is relatively easy to salvage—but a defective casting is usually worthless.

Owens emphasized the importance of rigidity checking for cracks that may be produced in welding. Although a crack may be invisible, operational stresses will cause progressive crack growth and premature failure. He described operation of Magnaflux, which checks a block for cracks, making use of a special magnetic powder sprinkled on the surface, and an electric current sent through the block. Wherever fields of force are interrupted by a crack, the magnetic powder leaves a tell-tale pattern.

Owens illustrated several welding techniques for joints, pointing out the importance of choosing the correct joint for accuracy and minimum stresses.

—by Bernard Kloehn, Field Editor

Ford Engineering School

The recently organized SAE student Club at the Ford Engineering School held its first technical meeting on Dec. 10. A short business session was followed by a talk and demonstration on "Torsional Vibration Damper Calibrators" by V.G. Raviolo.

The speaker, who is faculty adviser to the Club and a Ford research engineer, briefly described typical torsional vibration dampers and calibrating techniques. The special problems introduced by use of the viscous friction dampers were more thoroughly explained. Devices developed by the Ford Research Laboratories to solve the problem were demonstrated, and theory and development behind the project were thoroughly explored. A lively question and discussion period followed.

Through a movie called "The Ford Rouge Plant," student members were able to follow the manufacturing process from the coal and ore docks through the steel furnaces, rolling mills, machine shops and all other phases, including the final assembly line.

—by Fred Stenning, Field Editor

About SAE Members

cont. from p. 68

CARYL C. LEWIS was recently among 15 employees of RCA Victor, who were awarded the RCA Victor Award of Merit for extraordinary job achievements during 1947. He is manager of the Home Instrument General Materials Division.

JOSEPH GESCHELIN, past vice-president of SAE, addressed the Traffic Club of Detroit at its opening meeting for 1948 on Feb. 24. The subject matter of the talk touched upon questions of natural resources, and an analysis of motor car design—current and future.

Recently graduated from the College of the City of New York, ALFRED M. MORROW has become a junior experimental engineer with the Le Roi Co. in Milwaukee, Wis.

FRED A. DIETZ is now employed by the Ford Motor Co. at Dearborn, Mich., in the Lincoln-Mercury Division.

Having resigned his executive posi-

tion to develop a consulting practice, W. R. BERRY is interested in acting as a liaison man in England for some American contacts.

Previously sales manager for the Scientiae Corp., Dayton, Ohio, and executive officer of his own company, called the Curtis Pump Co., since 1938,

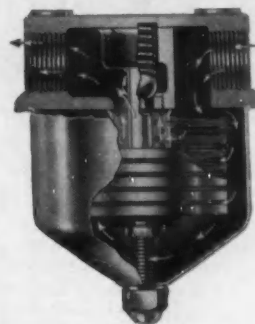
FREDERICK W. HECKERT is now owner of a company under his own name and is vice-president and secretary of the Curtis Pump Co., both in Dayton. In 1929, Heckert was chairman of the Dayton Section. At that time it was known as the Southern Ohio Section.

After 6½ years of service with the U. S. Air Force, LT. COL. NATHAN ROBERT ROSENGARTEN was recently honorably discharged. He is now assistant chief of the Flight Research Section of the Flight Test Division of the Air Force at Wright Field.

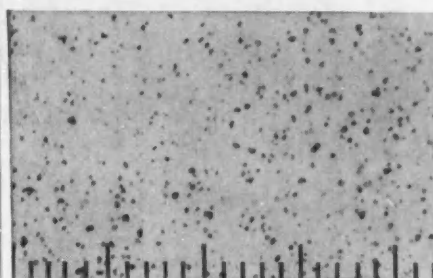
Prior to becoming a partner in Trail-A-Boat, Los Angeles. WILLIAM EDWARD HANN was a partner in the patent law firm of Harness, Dickey & Pierce of Detroit.

As advertised in TIME and NEWSWEEK

How Air-Maze filters



kept "dirty" oil clean



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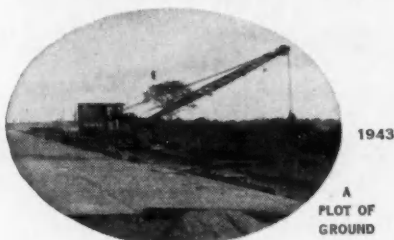
LIQUID FILTERS
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Silicone News

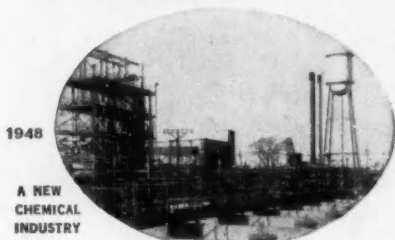


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1943—We started to build a plant and a main office in Midland, Michigan.

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Formerly an instructor at the University of Minnesota in Minneapolis, **ROBERT R. JOHNSON** recently became a junior stress analyst with the Cleveland Diesel Engine Division of General Motors Corp.

CHARLES I. LATHREM is now owner of his own company in Dayton. They are consultants in the private plane propeller field and are studying present propellers and methods of simplification. Lathrem was a member of the 1947 Aircraft Powerplant Activity Committee.

HARRY R. RICARDO has been decorated Knights Bachelor. He is chairman and technical director of Ricardo & Co., Ltd.

Formerly assistant to the general sales manager at the Macmillan Petroleum Corp. in New York City, **ROBERT DUNN** was recently advanced to the post of sales manager, Lubricants, Eastern Division. He will have complete charge of all marketing and sales of lubricants in corporations in this division, which consists of 19 states from Maine to Florida.

The International Cooperative Petroleum Association recently established headquarters in New York City, with **LLOYD R. MARCHANT** as general manager. There are 23 organizations representing 18 nations of the world affiliated with this Association.

Heretofore a branch manager with the Trailmobile Co. in Omaha, Nebr., **ERVIN V. ANDREWS, JR.**, has become a truck salesman with the White Motor Co., same city.

HOWARD JARMY was recently made research assistant for the Illinois Institute of Technology, Mechanical Engineering Department, in Chicago. Prior to this post, he was assistant chief engineer for the Muskegon Motor Specialties Co. in Muskegon, Mich.

Prior to becoming a truck manager for "L" Motors, Inc., New York City, **WILLIAM F. MAGUIRE** was connected with the Lily-Tulip Cup Corp. of College Point, N. Y. In the past he has served with a few large companies, including 15 years with the GMC Truck & Coach Division. In 1940 Maguire was secretary of the SAE Baltimore Section.

ALDEN E. ACKER has become general manager of the Pryor Mfg. Co., Western Division in Pasadena, Calif. He had been works manager for the General Tire & Rubber Co. of Calif., same city.

Preceding his appointment as branch manager of the Sacramento Branch of the Fruehauf Trailer Co. of Calif. in Los Angeles, **ALLEN K. TICE** was vice-president and director of sales for this company in Detroit.

MELVIN E. GEISER is now an instructor at The Pennsylvania State

College in State College, Pa. He was previously a designer with Hamilton Standard Propellers Division of United Aircraft Corp., East Hartford, Conn.

Until recently a development engineer with the Barber-Colman Co. in Rockford, Ill., **KENNETH D. REED** is now a project engineer at the West Bend Aluminum Co. in Hartford, Wis.

M. M. BURGESS, president of Sheller Mfg. Corp., announced the acquisition by his company of Dryden Rubber Co., organized in Chicago in 1901. They manufacture a wide line of rubber products.

DR. ALY SHOEB is now technical manager of the Mistr Engineering & Car Co. in Cairo, Egypt. Prior to this post, he was general manager with the Egyptian Road Transport Co. in Alexandria, Egypt.

No longer employed by the Ford Motor Co. of Canada, Ltd., **E. L. SIMPSON** has become managing director and chief engineer of the Continental Model Railways, Ltd., Windsor, Ont.

ALDEN B. CARDER recently became project coordinator in charge of Murac, Calif., operations for the Douglas Aircraft Co., Inc. Prior to this post he was assistant director of flight operations for the company.

Now affiliated with the U. S. Patent Office, Department of Commerce, Washington, D. C., as a patent examiner, **RAYMOND HUFFORD** had been an aircraft installation engineer with the Allison Division of General Motors Corp. in Los Angeles.

Until recently a major general in the U. S. Army, **STEPHEN G. HENRY** has been appointed special assistant to the vice-president and general manager of Ethyl Corp., Baton Rouge, La.

Formerly assistant to the owner at the Reg Beezley Auto Service, Memphis, Tenn., **DUFF GREEN, JR.**, recently became district service representative of the Memphis District for the Kaiser-Frazer Sales Corp.

G. G. A. ROSEN, director of research of Caterpillar Tractor Co., was guest speaker on Exploring the Unknown on March 14 over the National Broadcasting System.

No longer a project engineer with Jack & Heintz Precision Industries, Inc., Cleveland, Ohio, **ROBERT F. KRUPP** has become project and development engineer with the Columbia Steel Co. in Pittsburg, Calif.

Heretofore a design analyst engineer with Sikorsky Aircraft Division of United Aircraft Corp. in Bridgeport, Conn., **H. ALAN DUGUID** is now service liaison engineer with Reaction Motors, Inc. in Dover, N. J.

Rapid Plane-Design Progress Complicates Airport Planning

Based on paper

By HARRY O. WRIGHT, JR.

Public Airport Service, Inc.

CONTROVERSIES over what's economical airport planning seem to stem from the fast-stepping art of aircraft design. Runway lengths and standards for them are the chief sore points of the problem.

Within the aircraft industry itself two distinct trends direct airport planning in opposite directions. Developments such as jet assists, cross-wind landing gear, and reversible pitch propellers indicate smaller future airports could serve aircraft needs. Yet ever-increasing size of transport planes and the advent of jet propulsion point to revision of current airport standards to provide longer and heavier runways.

At any rate, Civil Aeronautics Administration runway standards were found inadequate and were just revised. Recent CAA hearings on formulation of new standards met with serious differences of opinion.

State and municipal governments, who maintain and operate airports, hold that future aircraft should be designed to operate from airports now under construction. The aircraft industry considers this a serious restriction on aircraft development.

Both arguments have merit. Biggest expense in the nation-wide airport construction program will be borne by local governments. Any great cost increases will diminish their interest in airport development. Yet no one wants to halt aircraft design progress.

Despite attempts of the CAA to reconcile differences in hearings, best way for reaching agreement on runway standards is on an industry level. Airport and aircraft design should be coordinated through a joint committee composed of members from the SAE, American Society of Civil Engineers, and the Institute of Aeronautical Sciences.

Too much emphasis on economy in airport planning for smaller communities today runs the danger of keeping them off the air-freight map. The 3500 and 4500-ft runways for Class II and III airports are too short for four-engine aircraft operation. Airport planners think only of passenger feeder lines, but neglect air cargo.

Freight hauling by air, in small communities, will far exceed their passenger operations. Facilities must accommodate four-engine cargo transports to handle the freight traffic. Already lack of adequate runways has forced discontinuation of service at some points, designed originally for only twin-engine aircraft. (Paper "Economical Airport Planning," was

presented at SAE National Air Transport Meeting, Dec. 1, 1947. This paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ members, 50¢ to nonmembers.)

Combustion Problems Dog Jet Development

Based on paper

By OPIE CHENOWETH

USAAF Power Plant Laboratory

REVIEW of the problems associated with new aircraft powerplants such as turbojets, turboprops, and ramjets, discloses that combustion problems are troublemakers with all of them.

Instead of the reciprocating engine's constant-volume combustion, these new types require constant-pressure combustion in a steady stream of air. Constant-pressure combustion is needed over a wide variety of combustion chamber velocities, but stream velocity must not exceed flame velocity under any conditions. Otherwise blowout occurs.

In the turboprop and turbojet engines, temperatures must not be so high that the mechanical limits of the rotating parts cannot withstand the stresses imposed on them. In order to keep temperatures reasonably low, the primary air, which unites with the fuel, must be diluted by secondary air.

Adding to the complication of burner design is the restriction on burner length. Fuel spraying, ignition, and mixing of primary and secondary air must be accomplished in only a few feet of burner length.

Little is really known about the fundamentals of the burning of complex hydrocarbons. It has been amazing to development engineers to find that relatively minor changes in design can produce major effects on combustion. Years of research and development may be required before a satisfactory amount of knowledge is accumulated.

Because the new engines handle not only the air for combustion but also the air for cooling, test equipment for the burner and the other components must provide tremendous air supplies. Some of the new engines consume 70 lb per sec, or over 2 tons of air per min. This is 10 times as much as some

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1009	C 1009	.09	.35	.010	.005	30	45	25	40
1010	C 1010	.10	.35	.010	.005	30	45	25	40
1011	C 1011	.11	.35	.010	.005	30	45	25	40
1012	C 1012	.12	.35	.010	.005	30	45	25	40
1013	C 1013	.13	.35	.010	.005	30	45	25	40
1014	C 1014	.14	.35	.010	.005	30	45	25	40
1015	C 1015	.15	.35	.010	.005	30	45	25	40
1016	C 1016	.16	.35	.010	.005	30	45	25	40
1017	C 1017	.17	.35	.010	.005	30	45	25	40
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1023	C 1023	.23	.35	.010	.005	30	45	25	40
1024	C 1024	.24	.35	.010	.005	30	45	25	40
1025	C 1025	.25	.35	.010	.005	30	45	25	40
1026	C 1026	.26	.35	.010	.005	30	45	25	40
1027	C 1027	.27	.35	.010	.005	30	45	25	40
1028	C 1028	.28	.35	.010	.005	30	45	25	40
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1047	C 1047	.47	.35	.010	.005	30	45	25	40
1048	C 1048	.48	.35	.010	.005	30	45	25	40
1049	C 1049	.49	.35	.010	.005	30	45	25	40
1050	C 1050	.50	.35	.010	.005	30	45	25	40
1051	C 1051	.51	.35	.010	.005	30	45	25	40
1052	C 1052	.52	.35	.010	.005	30	45	25	40
1053	C 1053	.53	.35	.010	.005	30	45	25	40
1054	C 1054	.54	.35	.010	.005	30	45	25	40
1055	C 1055	.55	.35	.010	.005	30	45	25	40
1056	C 1056	.56	.35	.010	.005	30	45	25	40
1057	C 1057	.57	.35	.010	.005	30	45	25	40
1058	C 1058	.58	.35	.010	.005	30	45	25	40
1059	C 1059	.59	.35	.010	.005	30	45	25	40
1060	C 1060	.60	.35	.010	.005	30	45	25	40
1061	C 1061	.61	.35	.010	.005	30	45	25	40
1062	C 1062	.62	.35	.010	.005	30	45	25	40
1063	C 1063	.63	.35	.010	.005	30	45	25	40
1064	C 1064	.64	.35	.010	.005	30	45	25	40
1065	C 1065	.65	.35	.010	.005	30	45	25	40
1066	C 1066	.66	.35	.010	.005	30	45	25	40
1067	C 1067	.67	.35	.010	.005	30	45	25	40
1068	C 1068	.68	.35	.010	.005	30	45	25	40
1069	C 1069	.69	.35	.010	.005	30	45	25	40
1070	C 1070	.70	.35	.010	.005	30	45	25	40
1071	C 1071	.71	.35	.010	.005	30	45	25	40
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1073	C 1073	.73	.35	.010	.005	30	45	25	40
1074	C 1074	.74	.35	.010	.005	30	45	25	40
1075	C 1075	.75	.35	.010	.005	30	45	25	40
1076	C 1076	.76	.35	.010	.005	30	45	25	40
1077	C 1077	.77	.35	.010	.005	30	45	25	40
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1080	C 1080	.80	.35	.010	.005	30	45	25	40
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1082	C 1082	.82	.35	.010	.005	30	45	25	40
1083	C 1083	.83	.35	.010	.005	30	45	25	40
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1085	C 1085	.85	.35	.010	.005	30	45	25	40
1086	C 1086	.86	.35	.010	.005	30	45	25	40
1087	C 1087	.87	.35	.010	.005	30	45	25	40
1088	C 1088	.88	.35	.010	.005	30	45	25	40
1089	C 1089	.89	.35	.010	.005	30	45	25	40
1090	C 1090	.90	.35	.010	.005	30	45	25	40
1091	C 1091	.91	.35	.010	.005	30	45	25	40
1092	C 1092	.92	.35	.010	.005	30	45	25	40
1093	C 1093	.93	.35	.010	.005	30	45	25	40
1094	C 1094	.94	.35	.010	.005	30	45	25	40
1095	C 1095	.95	.35	.010	.005	30	45	25	40
1096	C 1096	.96	.35	.010	.005	30	45	25	40
1097	C 1097	.97	.35	.010	.005	30	45	25	40
1098	C 1098	.98	.35	.010	.005	30	45	25	40
1099	C 1099	.99	.35	.010	.005	30	45	25	40
1100	C 1100	1.00	.35	.010	.005	30	45	25	40

*Yes,
standardization
is
desirable...*

... but it can also cause trouble when it comes to Cutting Fluids

While it is obvious that the number of different types of cutting fluids used in any plant should be kept to a minimum, over-standardization can be very costly. There is no universal "one-shot" cutting fluid. The many variables involved in the wide variety of machining operations encountered in most shops make it difficult for any one individual to make the most intelligent selection and application of cutting fluids. The D. A. Stuart Oil representative has behind him the resources of 82 years' company experience, a finely equipped laboratory and a sound list of products. He will not be unsupported when he calls to help you. His recommendations will not call for more different fluids than are essential to maximum performance, but on the contrary, may result in a decrease in the number of oils used in your shop.

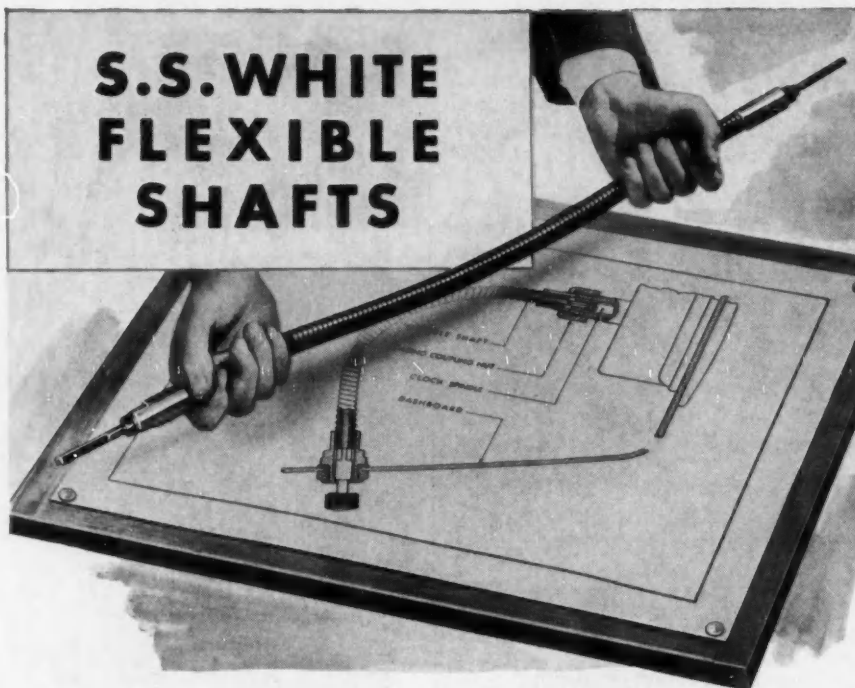
Literally thousands of authenticated case studies prove Stuart products, coupled with Stuart service, almost always result in greater production, better finishes and longer tool life. Don't overlook the opportunities afforded by proper cutting fluids properly applied. Write today and ask for D. A. Stuart's booklet, "Cutting Fluids for Better Machining".

STUART oil engineering goes with every barrel

D. A. Stuart Oil Co.
EST. 1945



S.S. WHITE FLEXIBLE SHAFTS

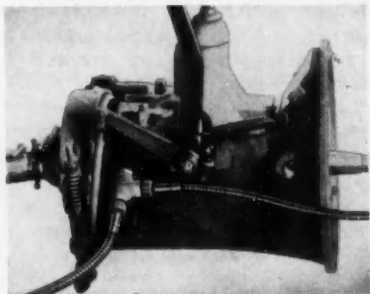


--- pave the way for new automotive accessories

S.S. White flexible shafts open up possibilities for new power driven accessories for automobiles, buses, trucks, tractors, etc. because they furnish an extremely simple answer to the big question—how are they going to be driven?

With a single shaft, easily installed out of the way all the way, rotary power can be taken from the engine, or from a separate conveniently placed small motor, and delivered to the accessory wherever it may be mounted.

In the same way, S.S. White "metal muscles"* pave the way for new accessories requiring manual or automatic control. With a shaft of the remote control type, smooth, sensitive control can be provided between any two points. This means that both the accessory and its control can be placed where desired.



This taxicab transmission shows a dual power take-off with one shaft driving the speedometer, the other the taximeter. Take-off can readily be made from various points.

For all the facts— WRITE FOR THIS FLEXIBLE SHAFT HANDBOOK

It gives full information and technical data about power drive and remote control shafts and how to work out applications. Copy, free, if you write for it on your business letterhead and mention your position.

*Trade Mark Reg. U.S. Pat. Off.



S.S. WHITE

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INDUSTRIAL

DIVISION

DEPT. J, 10 EAST 40th ST., NEW YORK 16, N. Y.



FLEXIBLE SHAFTS • FLEXIBLE SHAFT TOOLS • AIRCRAFT ACCESSORIES
SMALL CUTTING AND GRINDING TOOLS • SPECIAL FORMULA RUBBERS
MOLDED RESISTORS • PLASTIC SPECIALTIES • CONTRACT PLASTICS HOLDING

One of America's AAAA Industrial Enterprises

of the largest reciprocating engines consume.

For the ramjet—which becomes effective at Mach numbers over 1—an enormous amount of energy must be supplied to the air stream just to provide the velocity for testing. The air must also be dried to prevent ice formation in the supersonic stream.

(Paper "Aircraft Powerplant Problems," was presented at SAE Dayton Section, Dayton, Ohio, Oct. 21, 1947. This paper is available in full in multi-lithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Break Down Gasoline To Basic Ingredients

Based on paper

By CECIL E. BOORD

Ohio State University

CHEMISTS are lots closer to finding what's in a gallon of gasoline now that over 176 pure hydrocarbons have been synthesized and engine-tested. This nine-year-old basic research program, being sponsored by the American Petroleum Institute, is beginning to yield practical benefits.

Gasoline is composed of several hundred different hydrocarbons and varies in make-up with type of crude and refinery run. Petroleum chemists are isolating single hydrocarbons and studying each to find ways of raising fuel octane number. They already have learned much about the characteristics and properties of many hydrocarbons. Technologists hope this will lead them to a chemically-pure motor fuel composed of but a single hydrocarbon.

Key to the program is synthesis of hydrocarbons, making them amenable to purification. General method of attack has been to produce saturates from unsaturated hydrocarbons by hydrogenation. Significant contribution already made by this program is the spectrographic "fingerprinting" of individual hydrocarbons. Pure hydrocarbons and standard spectrometric equipment were used to prepare spectrograms.

Synthesis, purification, and determination of properties are conducted at Ohio State University. Both General Motors Corp. and Ethyl Corp. are testing the hydrocarbons in engines at their research laboratories.

Many feel this work will pay in conservation of natural resources and will yield a profitable return to both the

automotive and petroleum industry. It will help the refiner meet the growing high octane demand by making "a silk purse from a sow's ear." (Paper, "The Component Parts of Gasoline," was presented at SAE Annual Meeting, Detroit, Jan. 16, 1948. This paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Good Labor Relations Will Cut Fleet Costs

Based on paper

By HERBERT I. SULLIVAN

Transportation Consulting Engineer

FLEET men can pluck many dollars from their maintenance costs by giving more attention to labor. Making the mechanic more productive demands understanding of his problems, planning of his work.

Sell the worker on the idea that his job is worth holding. Eliminate hazardous working conditions. And don't expect satisfied, efficient mechanics unless you keep the shop clean, well-heated, free of fumes, properly lighted and ventilated.

Assign your men to the jobs they do best—those satisfied with doing the same work over and over again to repetitive jobs, conscientious and able men to precision work. Treat older workers so they'll feel an obligation to help younger ones do their jobs better.

Never criticize a mechanic in the presence of others. Supervisors must do it in a constructive, kindly manner. Work well done should be rewarded with promotions to better jobs. Establish a definite promotion plan. Make it clear that promotion depends on performance, not favoritism. But don't make promises you can't keep.

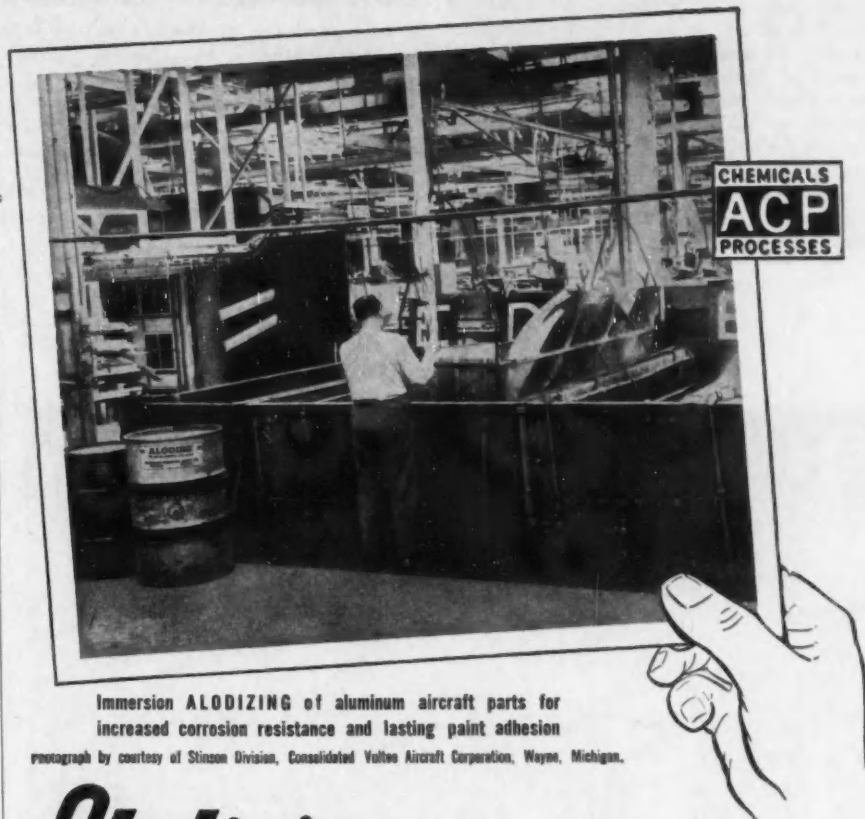
Supervisors should lead, not drive men. Jobs must be planned so that each man knows there's another job ready when he completes the one he's on. Otherwise, he'll say to himself, "Since there is nothing else ready, I'm going to look busy until another job shows up. I'm not going to work myself out of a job."

Encourage suggestions from workers for improvements in working conditions, in repair and inspection techniques. If you can't carry out the suggestion, explain to the employee why it can't be done.

Don't let grievances slide. Get to the bottom of each one and clear up any misunderstandings, or take necessary corrective measures without delay.

Carefully selecting new personnel will eliminate many later headaches.

Picture of Progress



Immersion ALODIZING of aluminum aircraft parts for increased corrosion resistance and lasting paint adhesion

photograph by courtesy of Stinson Division, Consolidated Vultee Aircraft Corporation, Wayne, Michigan.

Alodizing ALUMINUM ASSURES CORROSION RESISTANCE -- TOUGH PAINT BOND -- DURABILITY -- BEAUTY



RUST PROOFING AND PAINT BONDING

*Granodine **
*Duridine **
*Alodine **
*Lithoform **
*Thermol-Granodine **

RUST REMOVING AND PREVENTING

*Desodine **
*Peroline **
PICKLING
ACID INHIBITORS
*Rodine ** ®

The new ACP process using "Alodine"® takes but 2 minutes by immersion—or 30 seconds by spray in a power spray washer. No electricity—no high temperatures—no elaborate equipment—no special skill, necessary.

"Alodine" imparts maximum protection to either painted or unpainted aluminum—provides a durable bond for tenacious finish adhesion.

Alodizing is simple, effective and economical—in large or small, intermittent or continuous production. Additional data available on request.

Pioneering Research and Development Since 1914

AMERICAN CHEMICAL PAINT COMPANY

AMBLER, PA.

Manufacturers of Metallurgical, Agricultural and Pharmaceutical Chemicals

It will keep labor turnover low. But by all means release the inefficient worker. Policies of this kind will pay big dividends in boosting maintenance labor's output. (Paper, "The Importance of Maintenance in Making Bus and Truck Operations Pay," was presented at SAE New England Section, Boston, Nov. 4, 1947. This paper is available in full in mimeographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

New Members Qualified

These applicants qualified for admission to the Society between Jan. 10, 1948 and Feb. 10, 1948.

Grades of membership are: (M) Member; (A) Associate; (J) Junior; (Aff.) Affiliate; (SM) Service Member; (FM) Foreign Member.

Baltimore Section: Walter W. Immel (M), Thurman Feldman Naylor (J), Samuel A. Whitehead (A).

British Columbia Group: Phillip McGarvie (A).

Buffalo Section: Churchill W. Bartlett (M), Peter Tauson (M).

Canadian Section: Chesley Raymond Brown (A), C. Bruce Douglas (A), J. Bernard Lavigueur (M).

Chicago Section: Charles R. Chapman (M), Hugh St. Clair Christian (J), John R. Danly (J), Joseph F. DiVito (J), James Russell Downey (J), Robert W. Fleming (J), Roy W. Green (M), W. D. Hissem (A), Arthur Harvey Ledyard (J), Carl Frederick Lindee, Jr. (J), Leonard F. B. Reed (A), Donald Eugene Sterling (A), James R. Taylor (A), Robert Irvin Traver (J).

Cincinnati Section: George E. Rice (A).

Cleveland Section: Aaron Jacob Copeland (J), Arthur Leslie Core (J), Arthur F. Fassnacht (M), Winston H. McPhail (A), Richard Lee Pearce (J), Clifford A. Reimer (A), John A. Turkopp, Jr. (J), J. C. Van Allen (A), Leonard J. Wagner (M).

Dayton Section: Lewis Albert Leonard, Jr. (J), Horace Robinson Lowers (J), Leslie H. Markham (J), Thomas O. Mathues (J), Robert P. Miller (J), Donald H. Whiston (J).

Detroit Section: Robert Frederick Andrews (J), John William Asselstine (J), William P. Balthrop (J), James D. Bettridge (A), Neil L. Blume (M), James Dean Campbell (J), James D. Cannon (J), Edward George Chapaitis (M), Thomas Chlebina (J), Earl S. Clifton (J), Jack Jacob Cornell (J), Walter C. Curtiss (J), Chester Gabriel Ferens (J), Duncan B. Gardiner (M), Gordon A. Gettum (J), Charles Norman Haskins (M), John C. Holley (A), Ralph H. Isbrandt (M), George E. Kentis, Jr. (M), Max Frederick King (J), Ralph C. Lord, Jr. (J), Alexander Marderian (J), Samuel S. Meadows (M), Robert George Rajala (J), Donald Joseph Sachs (J), Theodore A. Schaad (M), Herbert Otto Heinrich Schmidt (M), J. F. Schraegle (M), James Victor Tierney, Jr. (J), Donald Graham Wright (J), Arthur P. Zaske, Jr. (J).

Hawaii Section: Albert J. Bravo (A), David A. Fleming (A), John Ross Hughes (A), William Waring Ruddock (A).

Indiana Section: W. S. Broffitt (M), Robert Lee Cain (J), Arthur Walter Christy (J), W. O. Sweeny (M), Armand L. Thielker (J).

Metropolitan Section: Eugene J. Bedell (A), Jack V. Casamassa (M), John M. Cole (J), Alan B. Gorman (M), Frederick J. Hart (J), Arthur S. Randak (M), Paul D. Rindfleisch (J), S. Merrill Skeist (J), Harold Reynolds Towers (J), Manuel Unterman (J), William Van Rosenbergh (M).

Mid-Continent Section: Carl C. Barnes (A), James Thomas Overbey (J), Fred M. Winn, Jr. (J).

If you Manufacture...



AUTOMOBILES



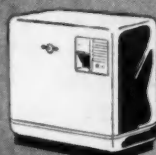
TRUCKS AND BUSES



COMMUNICATION TRANSMITTERS



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DISPENSERS

YOU CAN SAVE *3 Ways*
WITH ESSEX "PACKAGED"
WIRING HARNESS.....

1 Engineering 2 First Cost 3 Installation

Scores of users have found that they save time, trouble and money by turning their electrical wiring harness problems over to Essex specialists.

Essex One-Source service handles the intricate job of producing lighting, ignition and control harness assemblies custom-built to your exact specifications and complete with all

manual and electrical control devices for quick, efficient installation.

Through intensive specialization in wiring harness assemblies, Essex has developed line production methods of manufacturing, assembly and inspection, for economical production of high grade, individually tested, specially engineered assemblies.

INVESTIGATE ESSEX "ONE-SOURCE" SERVICE TODAY!



ESSEX WIRE CORPORATION

WIRE ASSEMBLY AND CORD SET DIVISION
SALES DEPARTMENT

MONTICELLO, INDIANA

Sales Offices: Chicago, Ill.; Cleveland, Ohio; Dayton, Ohio; Detroit, Mich.; Kansas City, Mo.; Los Angeles, Calif.; Milwaukee, Wis.; Newark, N. J.; Philadelphia, Pa.; San Francisco, Calif.; St. Louis, Mo.

Milwaukee Section: Bruce Edward Hover-son (J), Daniel R. Nettesheim (J), Henry Hice Wakeland (J), Max D. Wolff (M).

Mohawk-Hudson Group: James C. Gallagher (A).

New England Section: Victor J. Baxt (M), David Allen Hoffman (J), James H. McManus (A), E. Earle Whitney (A).

Northern California Section: Eldon C. Beagle (J), J. Elwood Fratis (M), Fred C. Hall (A), Ernest L. Hargrove (A), Harold H. Hunt (A), Harry G. Nagel (A), Harold Eugene Stoner (J).

Northwest Section: (Miss) Betty La Rue Bunte (J), Willis Arthur East (J).

Oregon Section: John Thomas Roberts (A).

Philadelphia Section: A. W. Bass, Jr. (M), Joseph A. Daley, Jr. (J), Maurice A. Hutelmyer (M), Lewis Frank Smith (M).

St. Louis Section: Thomas R. Magowan (A).

Salt Lake Group: Robert Derrill Taylor (A).

Southern California Section: Alex Bertea (M), Frederick Arthur Dobbratz (J), William L. Duval (J), Herman S. Fleck (M), Kingdon Kerr (M), George McLaren (A), Duncan K. MacLennan (A), Virgil F. Simonick (M).

Southern New England Section: Russell Frederick Bray, Jr. (J), Robert C. Duffie (J), Lawrence M. Rogers (J).

Spokane Intermountain Section: Fulton Clement McInerney (J).

Texas Section: Richard A. Flume, Jr. (J), Robert Herrick Kolb (J), Helmuth O. Saur (A).

Twin City Section: Virgil Howard Johnson (J), Carroll M. Martenson (J).

Virginia Section: Leroy P. Amick (M), E. W. Jones (A), Charles L. Young (A).

Washington Section: Ensign Marshall Allen Ricker (J), Charles Harrison Warner (A).

Western Michigan Section: Robert H. Sanborn (J).

Wichita Section: Harry R. Soderstrom (M).

Outside Section Territory: Max Dach (M), Howard W. Elser (A), Abraham Jacobson (A), Richard Ernst James (J), Everett Malcolm Johnson (J), Carl DeWalt Lynn (J), John C. Miles (M).

Robert B. Pennington (A), Frank Joseph Roehrenbeck (J), Milton V. Smith (A), Raymond B. Smith (M).

Foreign: Percy Scott Bramwell (FM), B.W.I.; William Glenn Burket (J), South Africa; Jack W. Dees (A), Egypt; Clarence Ferry (A), N.W.I.; Venceslas M. E. Figl (FM), Czechoslovakia; Don Hunter (J), Australia; N. Gunnar Karlborn (FM), Sweden; John Thomas Krycho (A), Brazil; Justo A. Odriozola (A), Mexico; Hjalmar Strom (A), Finland; Noel Totti, Jr. (J), Puerto Rico.

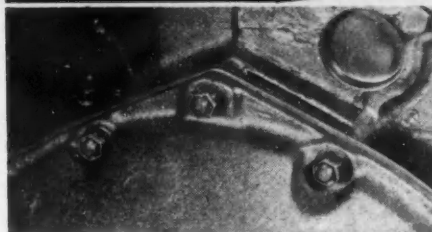
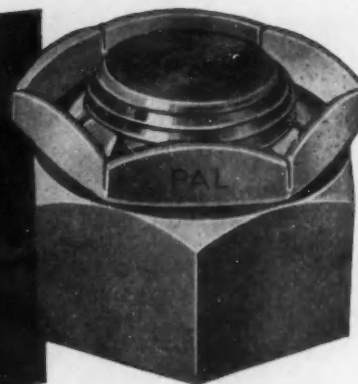
Applications Received

The applications for membership received between Jan. 10, 1948, and Feb. 10, 1948, are listed below.

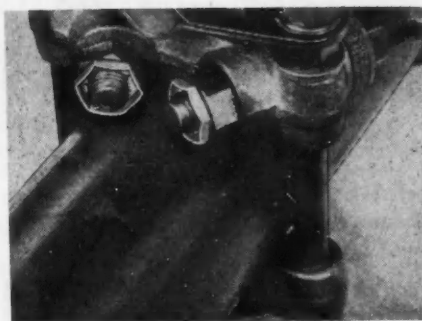
Baltimore Section: Joseph John Gouza, John W. Thompson.

British Columbia Group: Elliott G. Barber, Frederick Phillip Holmes, W. H. Traeger, H. J. Williamson.

**Absolute security
for
bolted assemblies
—at low cost!**



PALNUTS lock regular nuts holding transmission housing to engine.



PALNUTS lock regular nuts on support for drive shaft tube.

WHEREVER a bolted assembly must stay tight in service, add a PALNUT self-locking nut on top of the regular nut. Here are the advantages:

- Holds regular nut and bolt to original tightness, under severest vibration
- Easy, fast assembly with hand or power drivers
- Regular nut and PALNUT cost less than most other locknuts
- Requires no more space
- Unaffected by heat or oil
- No damage to nut or nut seat
- May be removed and re-used

The unfailing security of PALNUT double-locking action is proved by the increasing use on connecting rods, brake parts, exhaust manifolds, body hold down, front and rear engine mountings, etc. Send details of your assembly for samples and data.

Note: This ad describes the regular type self-locking PALNUT used as a locknut. Many other types available for use as self-locking load-carrying nuts for assembly of moulding, medallions, nameplates, etc.

THE PALNUT COMPANY

70 CORDIER ST., IRVINGTON 11, N. J.

Detroit Sales Office:

5-213 General Motors Bldg., Detroit 2, Mich.

PALNUT
TRADE MARK

Self-Locking

NUTS and FASTENERS



Buffalo Section: Huibert Jan Beke, Walter Crafts, Henry J. Falkowski, G. Thomas French, Jr., James Richard Petters, Robert A. Schaefer, Damon L. Westcott.

Canadian Section: John Crawford Annesley, W. Arch Bryce, Richard C. Cline, William Phillip Court, C. S. Finkle, George Ralph Giles, Alvin E. Jennings, Sidney S. Rogers, William Arthur Woodcock.

Chicago Section: Paul F. Allmendinger, George Hauser Amberg, Bennis George,

William Benefiel, Raymond F. Christopher, Jack E. Cole, Marvin W. Dundore, Irving Eugene Hand, C. F. Herman, Edward Charles Levit, Albert E. Mansfield, Jr., John R. McGuire, Henry Gunther Mueller, Frank W. Squire.

Cincinnati Section: Harry E. Brazier, Fred W. Dries, Edward E. Strike.

Cleveland Section: William P. Adams, Arthur P. Armington, Helmuth W. Engelman, Harold A. Hilgendorf, N. S. Nandeeswralya, Millard A. Rhoads, Carl G. Russell, Harold Charles Schin-

dler, Edward Wilson, Paul Smith, Thomas C. Spase, Paul C. Taylor, Robert E. Witter, George W. Wolff.

Dayton Section: Ralph James Hooker, Paul H. Mader, William A. McDorman.

Detroit Section: John S. Andrews, John Spencer Arend, Gayle H. Bowers, Raymond Frank Brozek, John R. Buckles, Darnall Burks, Roland H. Burks, Jerome S. Buzzard, Daniel A. Damm, Edward James Delahanty, Carl H. Exselsen, Chester J. Gorczyca, Fred-eric Joseph Haberkern, Arthur N. Haskell, Sidney S. Hatch, Edward J. Herbenar, Franklin R. Hight, Frank C. Holt, Burke M. Hyde, Jr., Thor S. Johnson, Walter E. Jominy, Wilson A. Jones, Albert T. Kelly, A. E. Kilpela, Hart M. King, John Peter Lekas, Charles C. Maynard, Richard J. McCafferty, Ray J. Miller, T. Edward Nelson, Harold T. Niles, Earl V. Olgren, Hiram R. Pacific, Von D. Polhemus, R. W. Rockefeller, Wilbur J. Sherrin, Burness Sprague, Robert F. Thomson, Louis H. VanDike, Jr., Arthur H. Zeitz, Jr.

Hawaii Section: Harvey P. Dawrs, Thorai E. Gilland, Lloyd Lowery.

Metropolitan Section: Julius Agin, Robert M. Bram, Eugene P. Burden, Joseph J. Burke, Robert E. Carbauh, Donald A. Howes, M. J. Johnson, Ben Karp, Thomas M. Mahoney, Ralph T. Millet, Louis F. Muller, Jr., Richard Edmund Robinson, Henry Scharf.

Mid-Continent Section: Walter H. Esser.

Milwaukee Section: Harry C. Eckles, William Anthony Grambo, Walter Carl Kroening, Timothy Medard Lawler, Jr., Edmund J. Pobar, Thomas Evander White.

Mohawk-Hudson Group: Dean L. Fisher, C. Eugene Lopez.

New England Section: James Harry Ostis.

Northern California Section: Harry D. Mahr, Lloyd T. McMahon, John Torik, Oliver Clare Whitaker.

Northwest Section: Robert Leonard Couture, George Ernie Murry, Louis W. Schroeder.

Oregon Section: Louis S. Kuhn, Glenn E. Stevenson.

Philadelphia Section: Toshiyuki Fukushima, Orian Samuel Reasor, Jr., F. Thomas Snyder.

Pittsburgh Section: Earl H. Davidson, Milton R. Rearick.

St. Louis Section: Albert D. Trager.

Southern California Section: Anthony V. Gentile, Harvey Frederick Gerwig, J. Kenneth Kennelly, Ray Lawrence, James L. Mahon, Harry Pappas, Jr., Robert A. Seling.

Southern New England Section: John Craig, Jr., David L. DeWolfe, Thomas E. Zeerip.

The Best Combination for FINE ENGINE PERFORMANCE



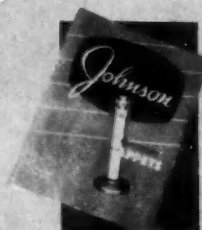
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ADJUSTABLE
TAPPETS

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Johnson
SELF-LOCKING
TAPPET SCREW

The Johnson Self-Locking Tappet Screw is made from the finest Steel, accurately heat treated to give it toughness and long life. The flexible spring action of the diaphragm holds the threads fully and rigidly seated at all times. The entire load is carried by the solid portion of the screw.

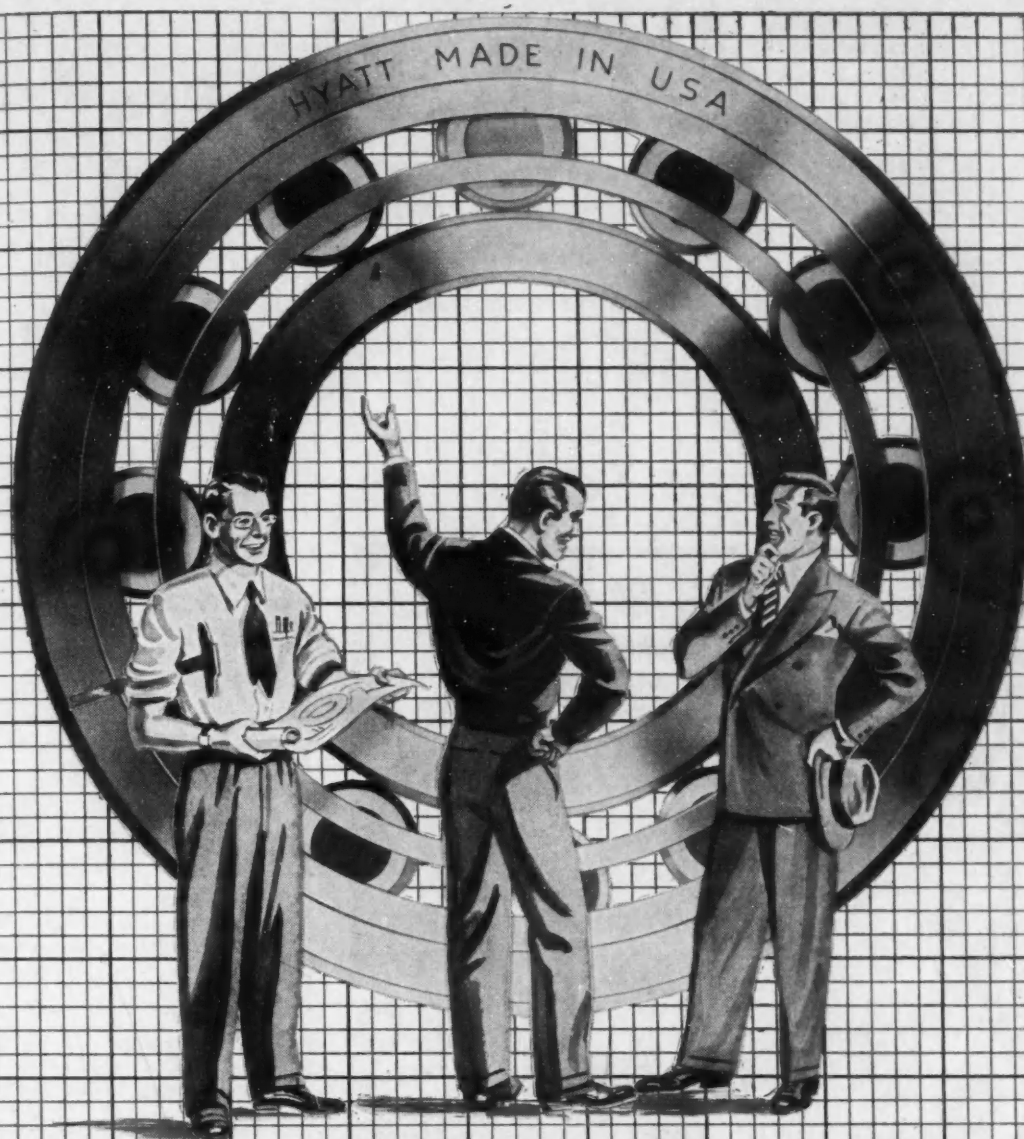
The Johnson Self-Locking Tappet Screw has no leading edges and is not self-tapping. Effectiveness is maintained through any number of adjustments.



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DESIGN ENGINEERS LIKE
the wide flexibility in machine design afforded by Hyatt Hy-Load Roller Bearings. TEN major types—greater load carrying capacity—for more compact, more efficient, more economical automotive and equipment design.

PRODUCTION MEN LIKE
the faster production schedules made possible by Hyatt Roller Bearings. The separable Hy-Load bearing parts are freely interchangeable; thus, when subassemblies meet for final assembly, no fussy selection or matching is required. Time and labor are saved.

CUSTOMERS LIKE
the smoother, quieter performance . . . longer life and care-free operation . . . for which Hy-Load Bearings have been recognized leaders for over half a century. For all-around satisfaction, depend on Hyatt. Hyatt Bearings Division, General Motors Corporation, Harrison, N. J. and Detroit, Michigan.

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Virginia Section: R. L. Brown, Jr., Patrick E. Garner H. Y. VanFossen.

Washington Section: Robert F. Harvey.

Western Michigan Section: Marvin J. Hui-
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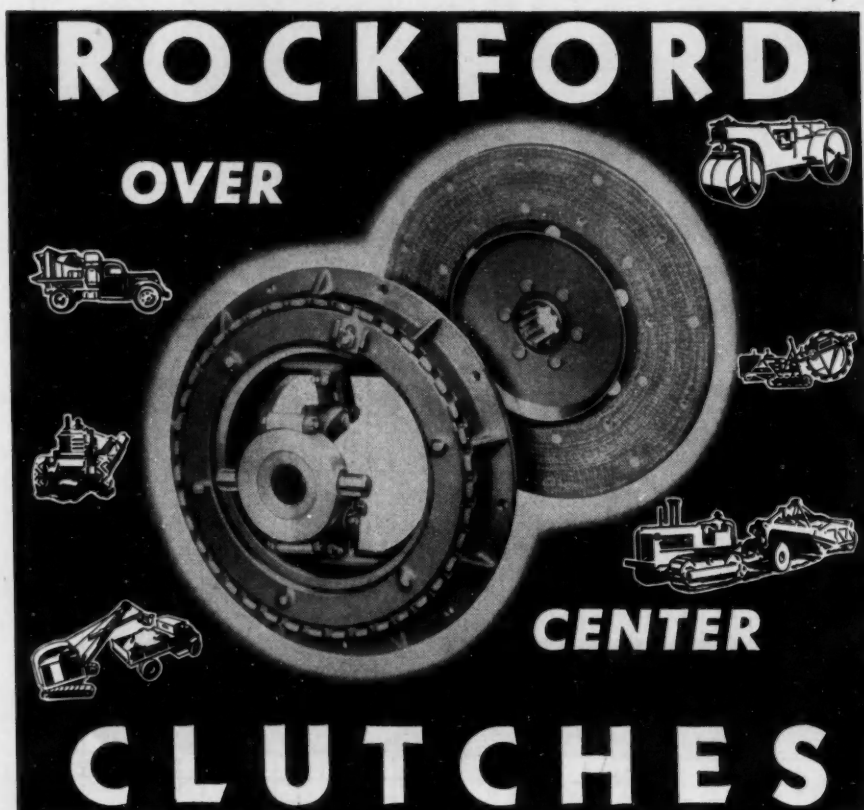
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